BETTER ULTRASOUND

Tips and Case Studies for the Clinical Ultrasound Practice

Lucas Greiner
Christian Jakobeit
Andreas Erhardt

English translation:
Karen I. Grützner

Table of Contents

Introduction

No matter if in general practice or in hospital, ultrasound can no longer be done without in daily medical life. The list of specialist disciplines that rely on it and trust its results is longer than the list of those, who can manage without it. Or the list of those, who think – whether rightly or wrongly remains to be seen at this point – they can do without by relying solely on computer tomography (CT), for example.

The comparison of illuminating the respective body region (such as the upper abdomen) with the help of a two-dimensional searchlight (and its interface reflexions) serves as an illustrative picture of sonography (Fig. 0.1). The addition of the many two-dimensional images results in a three-dimensional image of the real-time situation – in the mind of the examiner (and as a video if requested).

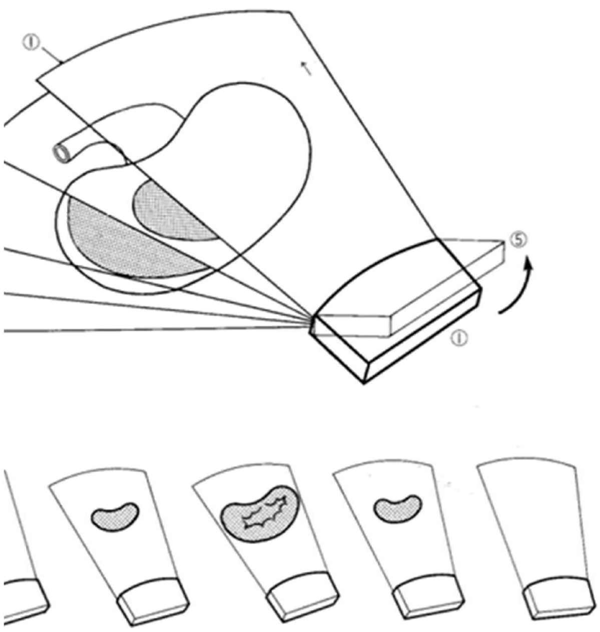


Fig. 01 Schematic dynamic representation of the scanning process ("cross-section pictures") compared to a two-dimensional searchlight (according to B. Braun)

This simple comparison represents besides real-time conditions, as well and above all, the free rotatability and plane selectivity, which the ultrasound possesses as additional unique characteristics.

Three-dimensional sonographic images become available in principle with high-end devices, and are not often used so far – except in gynaecologic-obstetric routine diagnostics.

Ultrasound is for the user primarily a piece of equipment, to help make rapid decisions what is to be done subsequently with the patient, with respect to diagnosis and therapy, and as a facilitator for confidence-building measures. An additional benefit is the uncomplicated monitoring possibility of clinical findings which is possible at any time.

Clinical sonography is particularly profitable because of its ubiquitous availability as a one person examination method, and when used together with the knowledge of the patient's medical history and basic clinical chemistry data in combination with clinical experience and sonographic expertise.

Furthermore, clinical ultrasound is known to be advantageous by its easy use (this is valid especially for the increasingly powerful performance of portable devices), and the seemingly relative ease of learning how to use it. The safe procedure and the closeness to the patient can create a tempting sense of security and trust with the patient, even when less experienced in its use.

Knowledge on sonographic performance is becoming more and more part of general learning. As a proof for this observation is the growing presence of this method in comics and general information during everyday life.

To conduct an ultrasound is a clinical art – the more so, if it is to be a good ultrasound; and who would even think of it without this sense of entitlement? Possibly the beginner, for whom this booklet was written, containing advice for the ultrasound examination of the abdomen and other body regions with numerous case studies, black and white or with colour, with or without contrast medium, interventional or without needle and drainage, simple or complex (and purposely only loosely structured according to organ systems, similar to that which is characteristic of the everyday working environment) – and without any claim to completeness.

Sonography requires taking a very close look and an adequate degree of creative association, as well as fantasy and clinical ability for deduction – not too much, but also not too little either.

Accordingly, we hope that this book may have many critical and creative readers and users.

Wuppertal and Remscheid, spring 2015

Lucas Greiner
Christian Jakobeit
Andreas Erhardt

Fig. 02 Overbearing apparatus over the examined and examiner

1 Before - Prior to Positioning the Transducer

1.1 Encounter and Clinical Examination

A decisive phase in clinical sonography is the moment after introduction of the examiner, recording of medical history, before setting the transducer into position, as well as the mutual getting to know each other of the examined and the examiner.

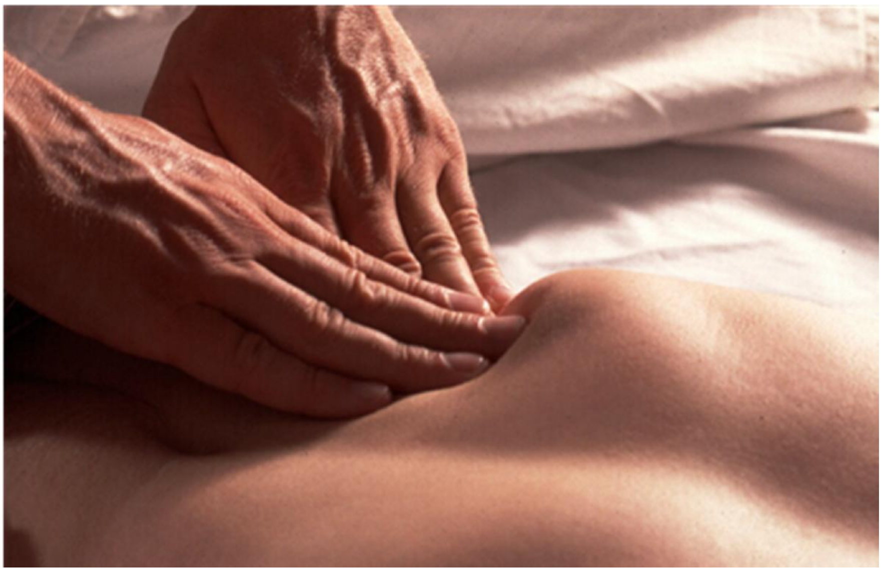


Fig. 1.1.01 Clinical Examination

Aside from these personal moments, the situation is linked for practical purposes with the essential questions regarding the ultrasound as such: What is the purpose of this examination? What can it accomplish and what not, where are its limits?

A short information on the safety of the procedure (for example the unproblematic conduct during pregnancy or other) should not be missed, nor the briefly kept references to its limits, and particularly to its repeatability at any time.

In any case the following should not be forgone! That is a quick glance at the patient history prior to the actual clinical sonography. It is good to know the essential patient data. Also, it makes sense to look only for organs that are (still) there (which is only partly the case for example after cholecystectomy or unilateral nephrectomy – a futile search for organs that are no longer present can mean a fair amount of sono-frustration.).

In the (mystic!) semi-darkness of the sonography room – which should hardly be given up in favour of the so-called daylight sonography – scars are often only unreliably recognizable, the more so as they become increasingly smaller by our surgeon colleagues.

Fig. 1.1.02   Darkened sonography room

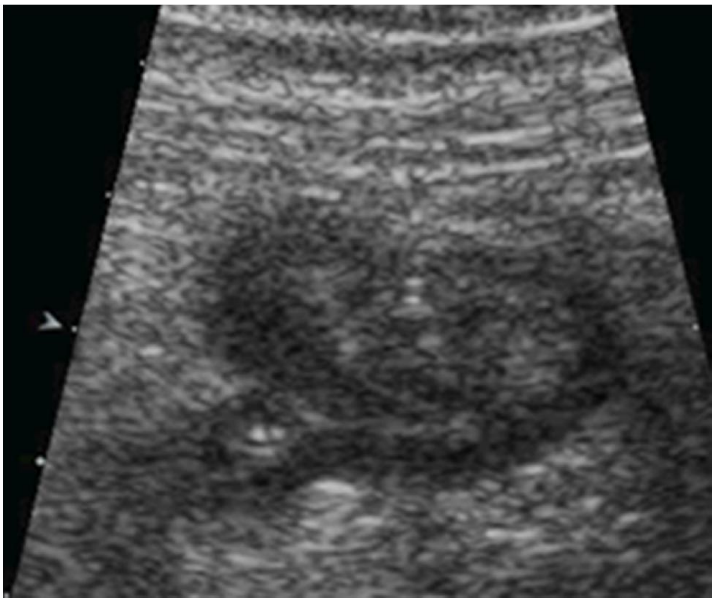


Fig. 1.1.03   Acute diverticulitis (clinical local pressure pain); LAS transverse

These questions, taking only a few seconds, usually provide informative answers and are well suited to inspire confidence in the patient. In this situation, the correct choice of words (adapted to the patient to be examined) is an essential part of the examiner's medical expertise.

Also, the thus invested time then becomes worthwhile, if there are such large lesions that are only poorly or not at all perceivable, but which are rather palpable. The expected examination horizon of the examiner is also substantially broadened and influenced by this.

Similar is lastly also valid for pain – in which case the examined erroneously believes that the described pain is part of the examination.

In analogy this is also true for the (brief) physical examination. It should never be omitted, an as already mentioned, it is not to be underestimated ("sono-psychology") – as this kind of attention is an expression of professionalism, even in the (still legal) borderline contact and touching of the examined.

Fig. 1.1.04 Physical (digital rectal) examination

Lastly impending is (this is not to be underestimated!) an undesired examination result; and occasionally, immediately and unexpectedly, the examined turns into a patient.

The fact that all body regions in question need to be scanned thoroughly does not actually need special mention. Benign focal lesions (FL) that were "newly found" not until the second examination, are especially then a problem, if they are then described seemingly for the first time in the context of an interim arisen malign illness.

Consequently, it is to be paid attention to a good general atmosphere; in particular the examiner should do nothing else than intently conduct the ultrasound examination. Necessary phone conversations and discussions with others are to be reduced to a minimum during the examination.

1.2 Device Settings

The screen should be used to the largest extent. Thereby multitudinous information should be masked, which is readily but superfluously, part of the manufacturer's default setting. Decisive are the real-time images, which stand for themselves. Technical details are of little interest and generally of limited information, they should only be available to whom they are of actual interest.

Additional information on "button science", as well as for example the choice of probe (transducer), or the use of colour-coded duplex sonography (CCDS) or contrast medium (CM) sonography, as well as "normal values", or focus area, or image artefacts should be explicitly limited to scientific literature. A (subjectively) "nice" picture may suffice; nevertheless adequate diligence should be applied to the device settings.

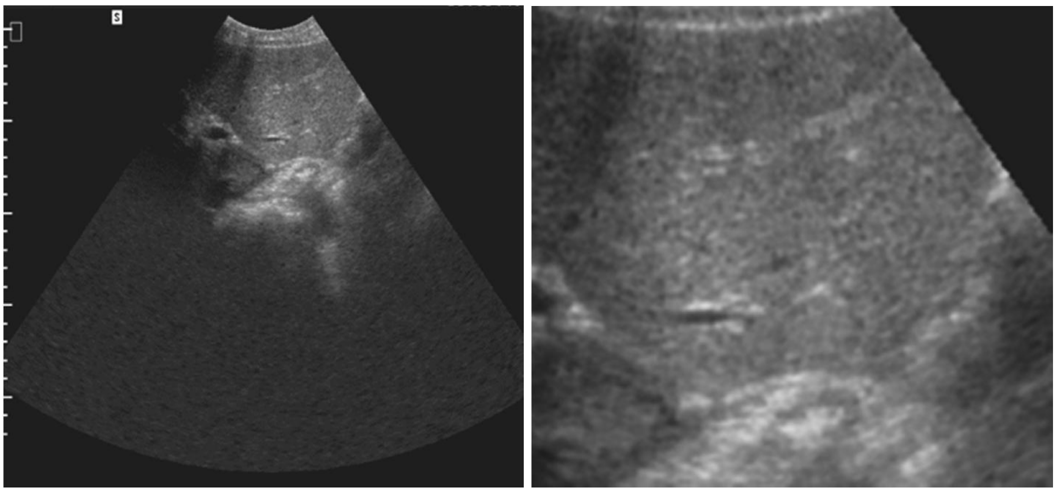


Fig. 1.2.01 a, b Format filling and format wasting use of a screen (b or a) – everything is included in a, but in b it can be discerned certainly quicker (e.g. normal cockade of the terminal oesophagus); modified LS

Once more: The ultrasound examination is only complete as a dynamic-active real-time examination.

With this, strictly speaking we arrived already at the next chapter: What is to be given special consideration during the ultrasound examination?

Please note:

- ***medical history and clinical examination – always!***
- ***explain purpose and limits of examination***
- ***mention harmlessness of ultra-sound***
- ***dedicate yourself to the patient***

2 During the Sonographic Examination

2.1 Preliminary Remarks

Sonography is not the contemplative viewing of a picture, but a dynamic-active examination. It can be conducted at any given time; and it is for example only necessary for questions regarding small gallbladder stones that the examined is sober – otherwise not.

The examination pathway starts with longitudinal then lateral and subcostal diagonal sections. The course of examination continues, after routine positioning (this should always be aimed at, as far as it is technically possible), with right-sided and left-sided flank sections, to then end at the lower abdominal sections (LAS).

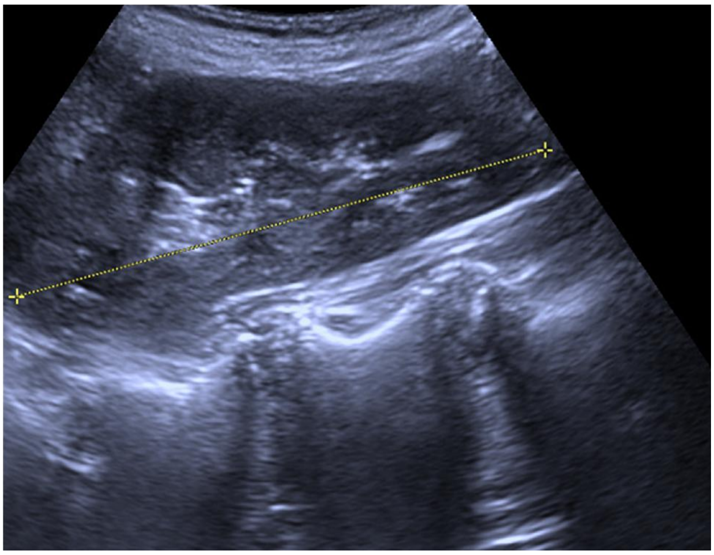


Fig. 2.1.01 Renal truncated sections as well as vertebral bodies, individual intervertebral discs, and in sections the myelon; FS right

Examiner and examined should always cooperate closely: During the initial and final supine position, when inhaling and exhaling, or breath-holding, and for example the subsequent subcostal sections (SCS). Cooperation is also important in lateral positions, the dosed compression, and – as far as possible – also for the establishment of medical findings and their individual interpretation.

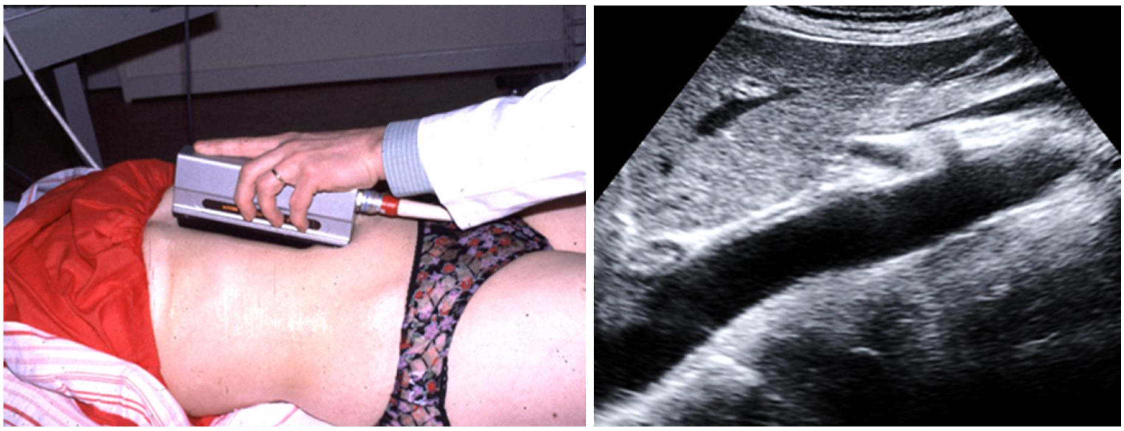


Fig. 2.1.02 a, b Supine position; note terminal oesophagus, LS

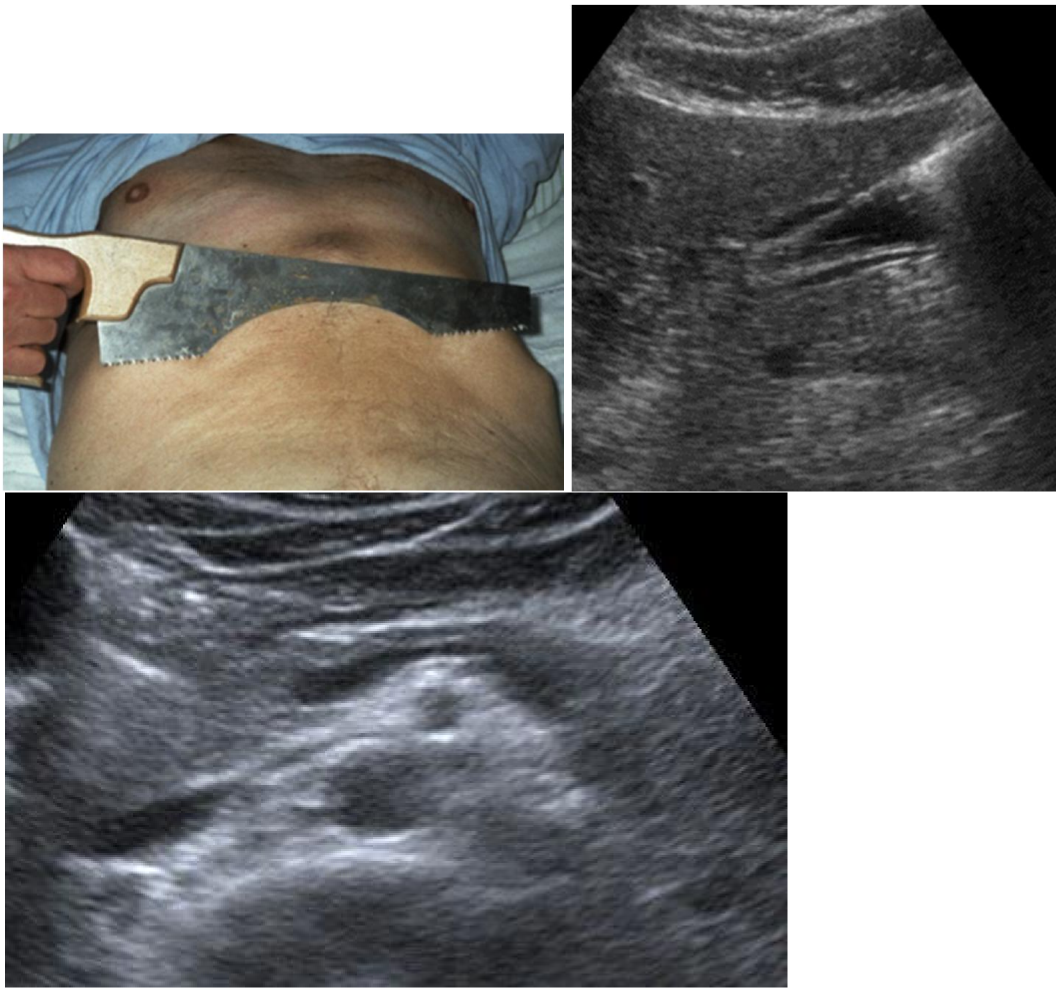


Fig. 2.1.03 a-c In order to demonstrate the procedure of sonography a saw was used (with cut out middle part) to demonstrate sonography procedure; antrum fluid filled (a), numerous details also in the somewhat mediocre figure (c) (abdominal wall, antrum anterior and posterior wall, pylorus, gas in bulb, pancreas, inferior vena cava, and entering left renal vein, which before runs staunched between superior mesenteric artery and aorta, traversing through diaphragm aorta, lymph nodes, vertebral bodies; UAS transverse

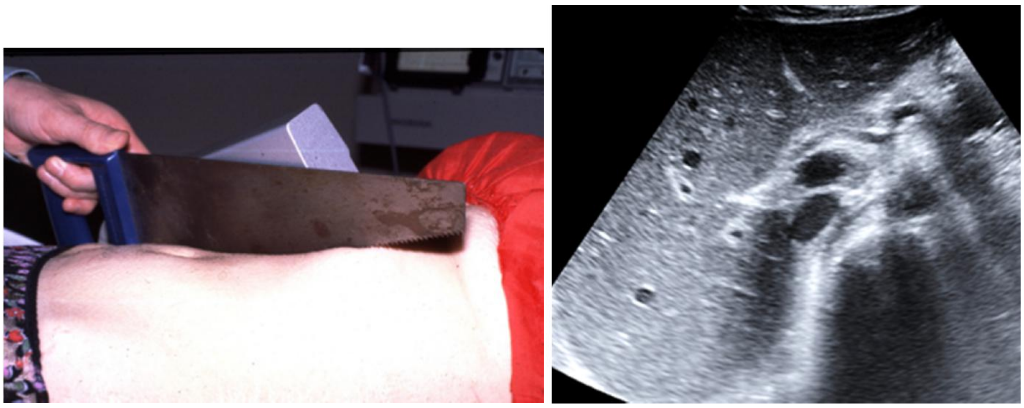


Fig. 2.1.04 a-c SCS live (a), as well as little (b), and steeply tipped (c)

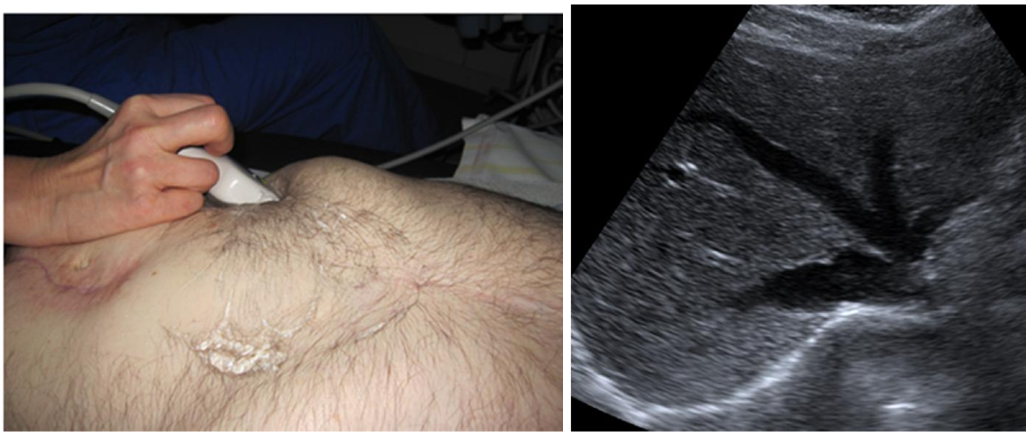


Fig. 2.1.05 a, b SCS with substantial compression and ample contact gel (a), image of the liver and hepatic veins, as well as basal lung (often erroneously ascribed as “diaphragm”), as well as actual diaphragm (b)

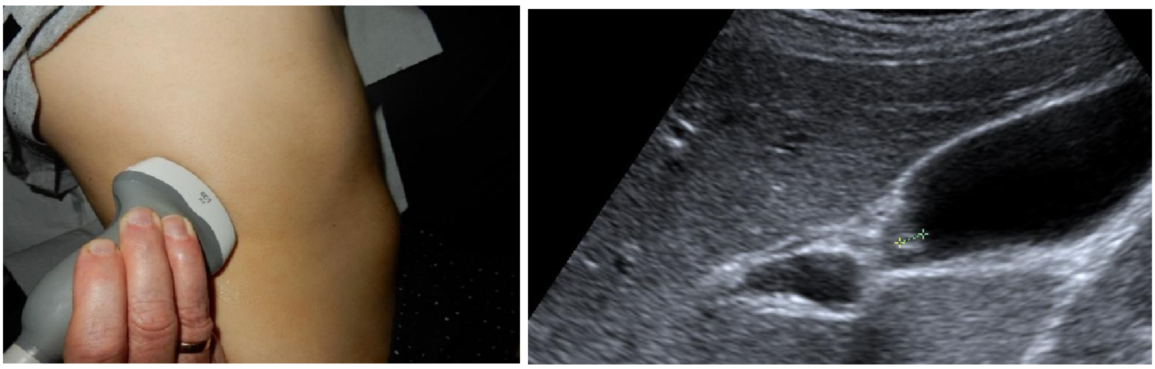


Fig. 2.1.06 a, b FS right with interjacent right branch of hepatic artery and normal sized DHC

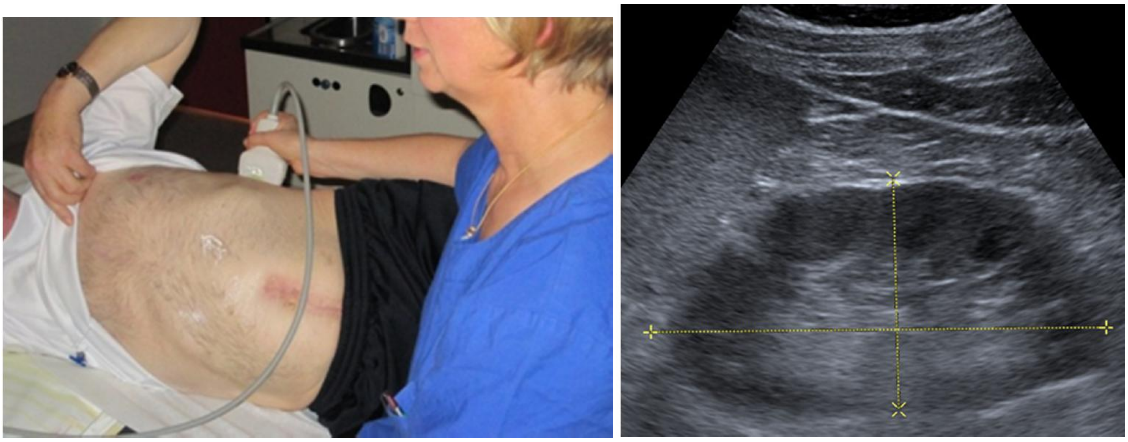


Fig. 2.1.07 a, b Right position live (a), and sonogram (b) with sections of spleen, FS right

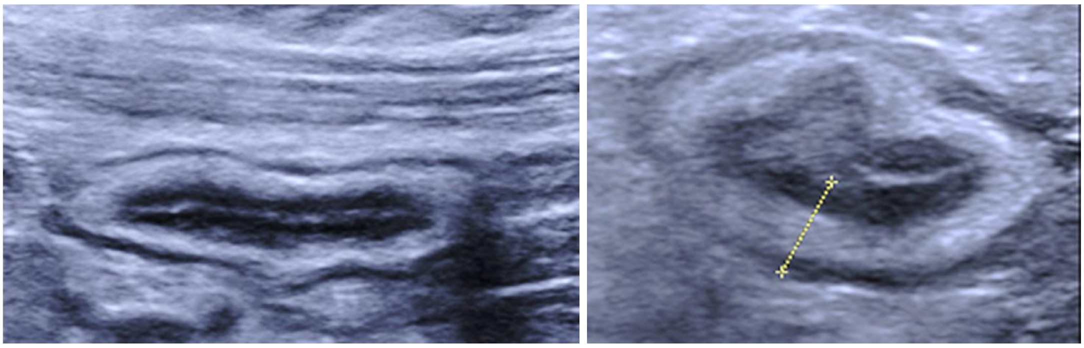


Fig. 2.1.08 Hypertrophied intestinal loops (clinical unspecific self-limiting enteritis); LAS transverse

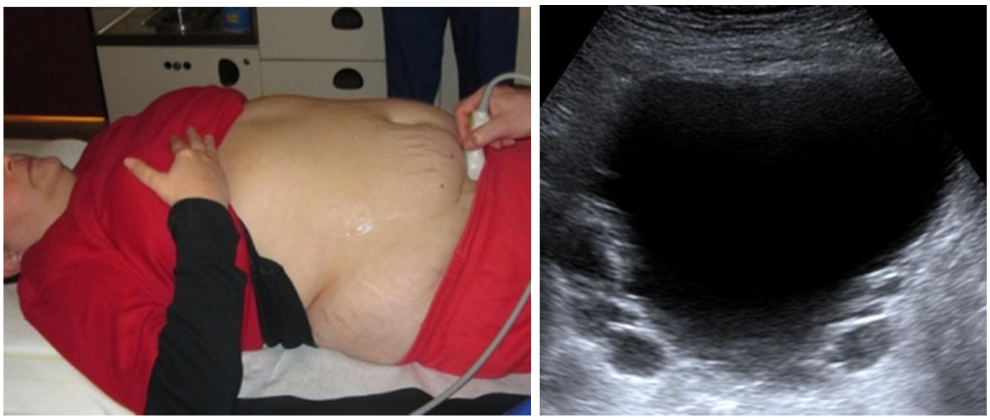


Fig. 2.1.09 a, b Urinary bladder diverticulum as an incidental finding (b); LAS transverse

Fig. 2.1.10 a, b Respiratory displacement before (a) and after (b)

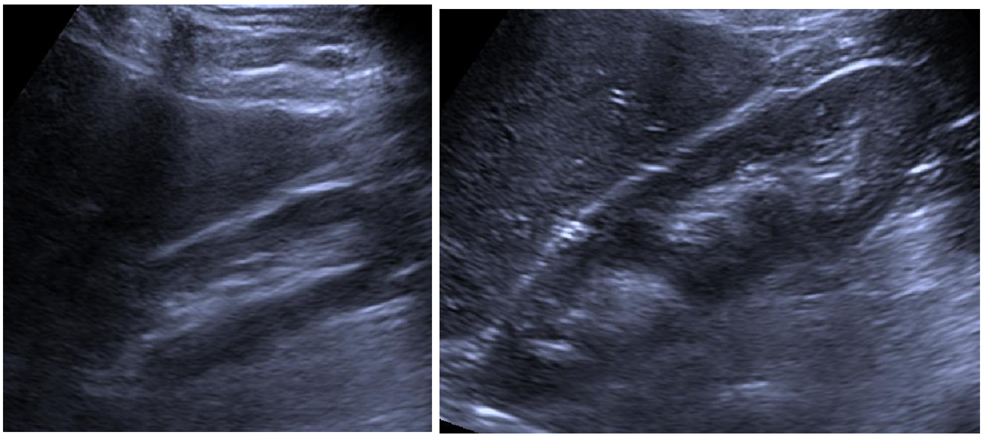


Fig. 2.1.11 a, b Displacement and optimization of image with exhalation (a) and inhalation (b) images; FS right

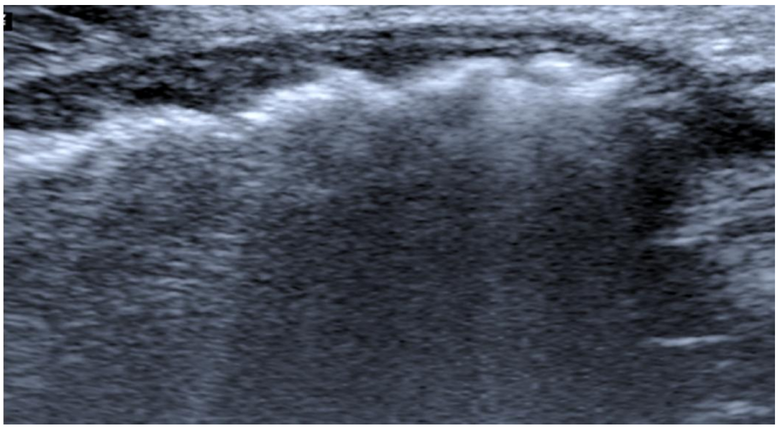


Fig. 2.1.12 Left flexure, intestinal gas expansion with slight wall-thickening colitis; FS left

Dosed compression serves two purposes: Firstly, disruptive intestinal gas is simply displaced, and secondly the distance between transducer and its focus area is optimized to the region of interest.

Targeted inhalation and exhalation frequently allow better imaging of a previously hard to display organ. Particularly the left hepatic lobe likes to lend itself here as a "sono-acoustic window".

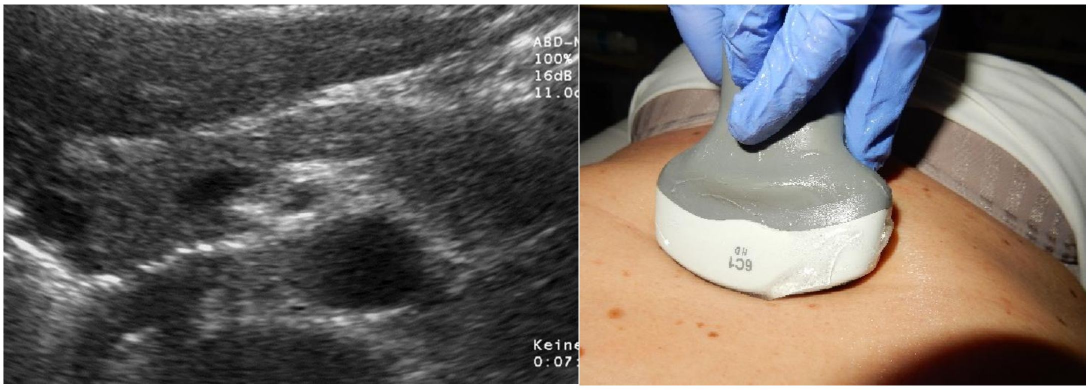


Fig. 2.1.13 a, b Left hepatic lobe as sono-acoustic window (deep inspiration and high setting tilted caudally); UAS transverse

Excursions, which are possible with respiration, can be considerable and are frequently underestimated – after all they make up several centimetres (according to body size of the concerned person).

Whereas these respiratory associated movements in the upper abdomen can be sometimes rather pronounced, they can be found to a lesser extent, to none at all, in the region of middle and lower abdomen.

The image compatible holding of breath – a routine part of our examination program – also allows to calmly examine those body regions which were so far insufficiently displayed.

Fig. 2.1.14 Symptom-free cholecystolithiasis; FS right

2.2 Examine Systematically!

The supine position, in which our abdominal status survey starts and ends, is a comfortable initial position for the person to be examined. Following the advice of Gerhard Rettenmaier, the examination goes along with defined right and left positions of the patient (volunteer), which is obligatory to allow repetition, if the examined can be burdened with it.

Often this "classical" examination system is deviated from, with different convincing arguments. This becomes of no particular interest; if an examination procedure is substituted, which in modified sequence records also as thoroughly and systematically all abdominal organs and possibly other regions.

Described selective information on pain, which at times has to be asked for in either bearing or indolent patients, is to be paid particular attention to, as it can lead to guiding evidence. This is also valid for other distinctive features.

A clear distinction should take place between findings, or the description of findings on one hand, and individual diagnostic assessments on the other. Findings must always be categorized individually adequately!

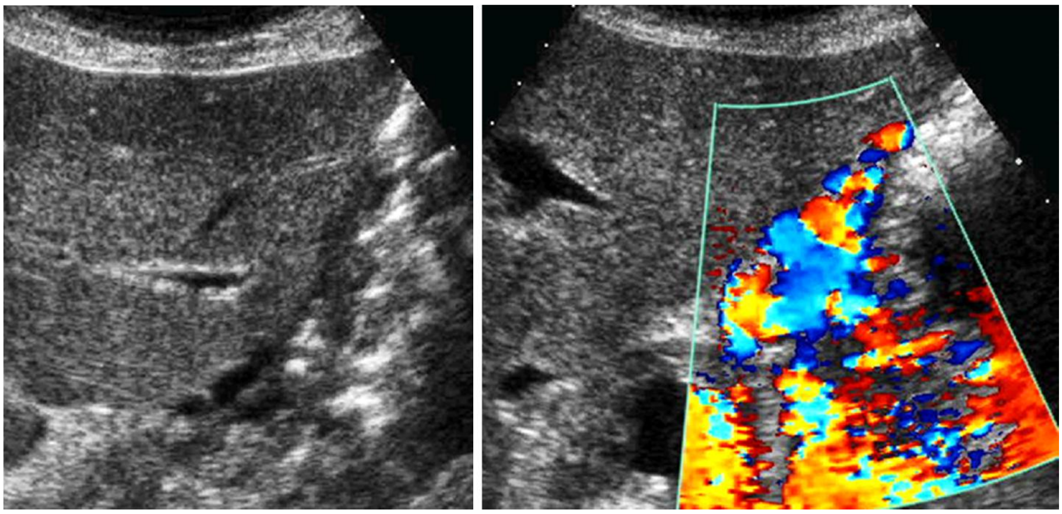


Fig. 2.2.01 a, b Gastric wall varicosis with portal hypertension as unintentional finding; UAS transverse (b with CCDS)

Often it is the second diagnosis that is determining, e.g. clinical symptom-free gallstones as unimportant initial finding, and then a clinical symptom-free renal tumour as relevant second finding. In other words: At least during the first examination, everything must be looked at!

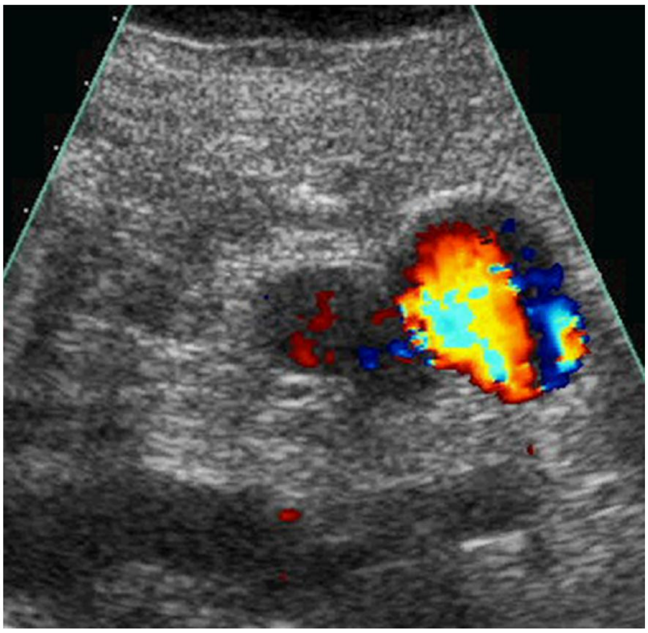


Fig. 2.2.02 Varicosis of the gastric wall, no intestinal loops on right; LAS longitudinal with CCDS

The completeness of the (initial) examination, as well as the willingness of the examiner to adequately position the examined are definitely suitable as evaluation criteria for the execution quality of the ultrasound.

In other words, adherence allows conclusions on the earnestness of the sonographic examination – or paraphrased once more, it can determine, if all possibilities of real-time sonography (including the frequently insufficiently appreciated motion phenomena) are sufficiently utilized.

Similar is also valid for visual palpation, the targeted touching and palpating of organs when viewing the ultrasound.

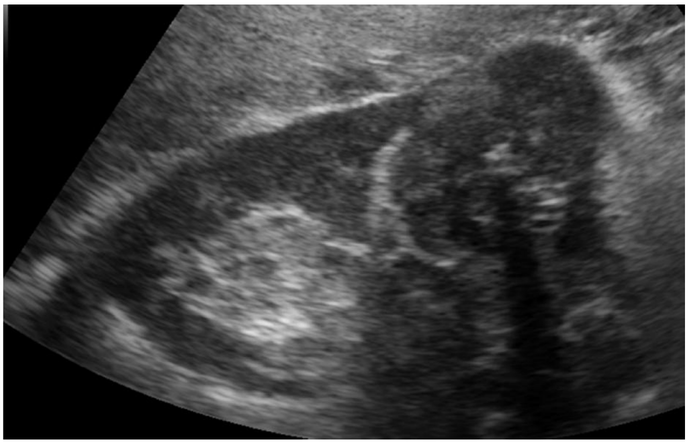


Fig. 2.2.03 Lower pole tumour of left kidney as incidental finding; FS left

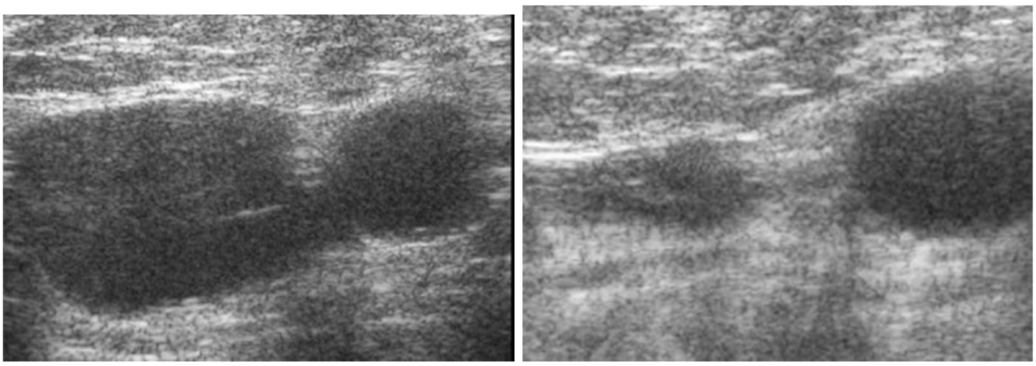


Fig. 2.2.04 a, b Examination of the common iliac vein on right without (a), as well as with minor (b) compression (conceivably easy thrombosis exclusion); LAS longitudinal

2.3 Visual Palpation

Indeed: Ultrasonography specifically allows targeted tangibility of organs and investigation with respect to consistency or palpation pain – a top grade unique feature of the ultrasonographic examination, which - as already mentioned - is often not applied enough or not at all.

Thus an unrivalled current image of events is created – for example in the abdomen – including the knowledgeable assessment of the examiner, if a normal medical finding or pathological event is present. Hereby it is easy to assign and localize pain according to organ (e.g. in acute cholecystitis), and to directly verify the consistency of an organ (e.g. liver).

2.4 Contact Gel

During sonography information on the necessary contact gel ("... it can easily be washed off") makes sense (Fig. 1.8). We deliberately forgo warming up the gel (using a baby bottle warmer or other) (a minor inconvenience is, so to speak, to be tolerated by the patient – another "sono-psychological" moment).

The use of contact gel should in fact be done sparingly in order to avoid unnecessary smearing; but on the other hand increasing image deterioration in the process of a longer examination can be ascribed to the drying contact gel.

The systematic approach, as already mentioned, always makes sense, even if one starts the examination with the spleen.

2.5 Spontaneous and Targeted Movements

2.5.1 Preliminary Remarks

One of the unbeatable advantages of real-time sonography is the immediate depiction of movements of any kind – no matter if actively intended, triggered by visual palpation, or passively imparted, as for example aortic pulsations, and naturally the displacements imparted by respiration.

The appropriate documentation is done as an image print-out or video clip, incidentally with the dynamics and help of which also a small revolution in the didactics of ultrasonography became possible.

2.5.2 Passive Associated Movements

2.5.2.1 Pulsation Associated Movements

Of the passive pulsations, notably the associated movements from aortic pulsations and the respiratory associated displacements are obvious.

All upper abdominal regions are affected without exception by these passive associated movements. The observation of elasticity – as subjective as this may always remain – and its more objective measurement ("elastography") are by all means of value as assessment criteria. The experienced examiner for example can deduct from it the presence of chronic-inflammatory or even malign growths.

The integration of sonographic findings and diagnoses is conducted for practical purposes in daily (radiologic) discussions, including for example the picture archiving and communication system (PACS).

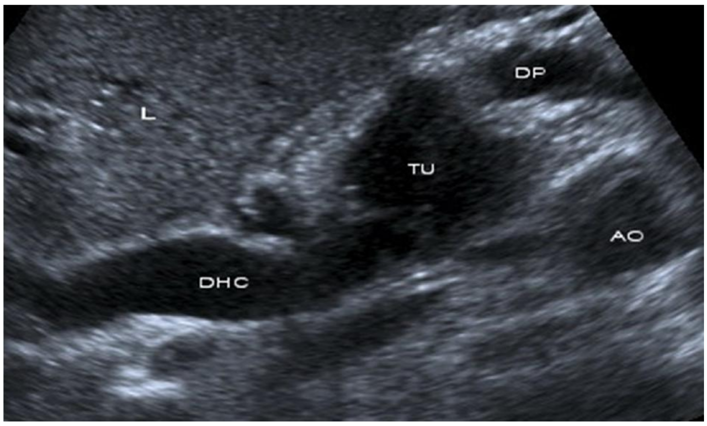


Fig. 2.5.02 Strongly suspected malignant pancreas head tumour (TU) without local pulsations and biductal stenosis, also truncated section liver, furthermore inferior vena cava, hepatic, renal and gastroduodenal arteries, small lymph nodes; UAS transverse

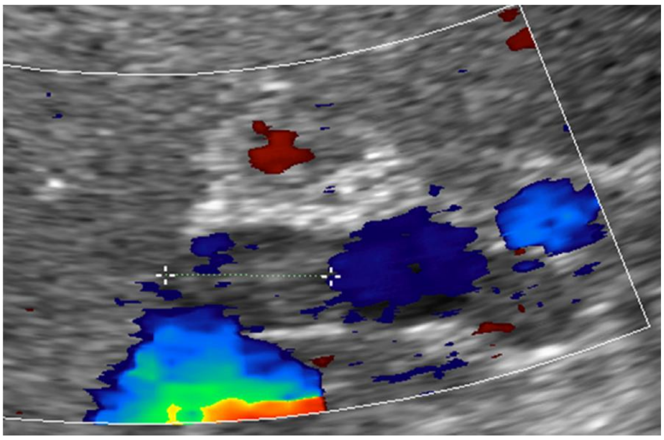


Fig. 2.5.03 Portal liver lymphadenopathy (measuring crosses), as well as displacement of hypertrophied hepatic bile duct pathway (clinical PSC), variant ventral hepatic arterial branch (red), partial section of tortuous portal vein (blue); FS right, CCDS (clinical typical PSC)

This is also valid for the more subtly evaluable, because weaker, associated pulsations of the splenic and portal vein.

The diligent observation of this "spontaneous elastography" makes it possible to carry out subtle diagnostics, even for individual organs and organ sections.

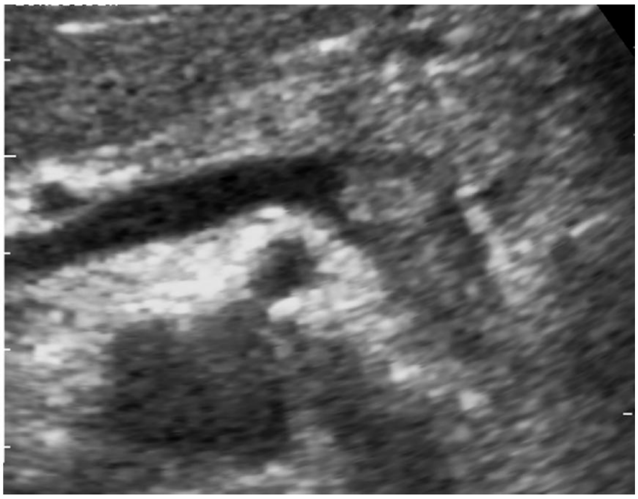


Fig. 2.5.04 Thrombosis of the splenic vein, in the dynamic image simply proven by the reflexibility of the intravasal thrombus material and its non-compressibility; UAS transverse

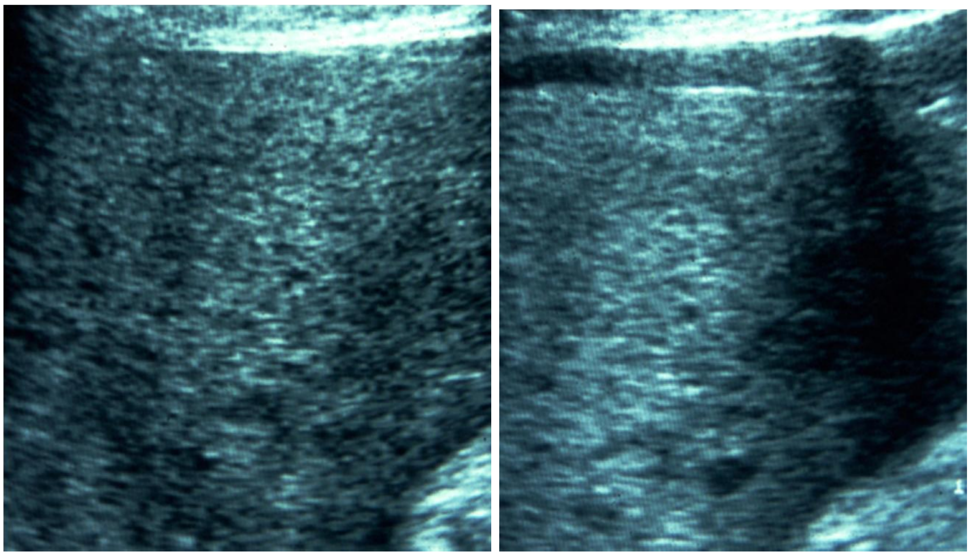


Fig. 2.5.05 a, b Minor amount of ascites (b) – seemingly vanished by too strong compression (or overlooked) (a); LS

It remains to be seen to which extent additional aspects may result, such as possibilities of measurability and objectivity.

Pain and described pressure pain symptoms, as already mentioned before, can be exactly documented point by point and assigned clinically by sonography (visual palpation).

2.5.2.2 Respiration Associated Movements

A similar concept is valid, to a small extent, for the respiration associated movements, which are imparted to the respective environment. They allow also the observation of spontaneous elastography.

Pneumothorax is for example characterized by the lack of respiration associated movement, particularly if a small pleural effusion can be verified, which can be seen much better in the sonogram as by radiology.

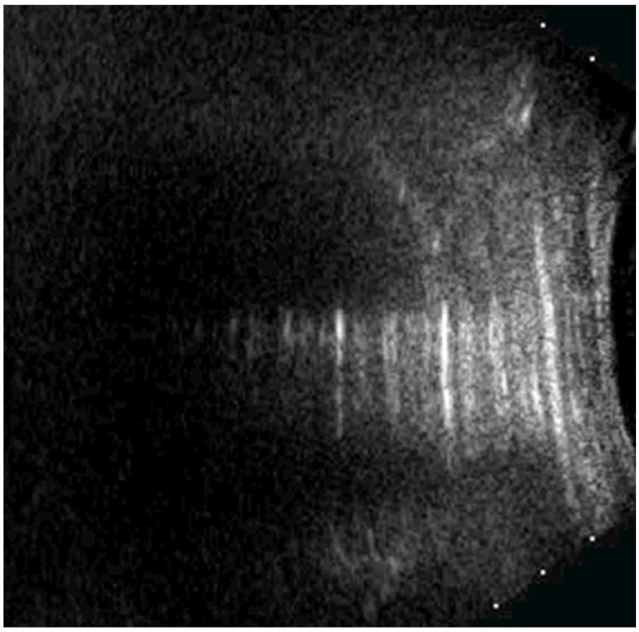


Fig. 2.5.06 Post-traumatic hydropneumothorax (effusion on right); ICS right while sitting

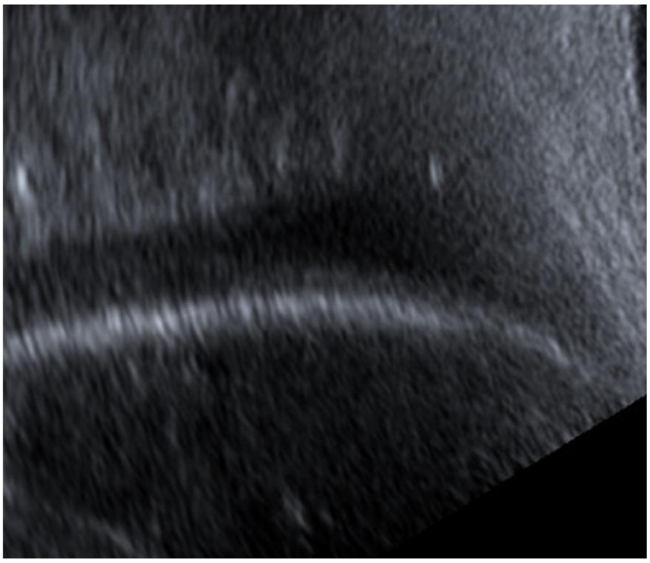


Fig. 2.5.07 Small pleural effusion right (evaded thorax x-ray); high FS right in sitting position

To emphasize again: Sonography is a dynamic screening method – a continuation of the clinical examination with a modern examination device, the sonograph.

The sonographic screening is to include the history-based clinical examination in every case. That the latter may have a larger part in the overall diagnoses, is a known fact.

Its subjectivity is hereby not disturbing – as this involves here another term for the very essential expression for experience.

2.5.3 Active Associated Movements

2.5.3.1 Respiration

Voluntary inhalation and exhalation go along with movements, which are – as mentioned before – frequently underestimated in its dimensions.

Accordingly, voluntary respiration – particularly holding one's breath – can be a good way of improving the image. This is particularly valid for the pancreas, liver, and gallbladder, as well as the lymph nodes of the (upper) abdomen. Furthermore, this can take place in addition to the involuntary respiration associated movements. Also this – admittedly somewhat more elaborate examination possibility – is not put to use often enough. The quality of an examination depends essentially also on these respiration manoeuvres.

An impaired diaphragm flexibility (e.g. in phrenic paresis) can become evident by the unusually elevated and respiration immovable organs of the right or left upper abdomen.

2.5.3.2 Positioning

As already mentioned, the comfortable initial position is the supine position, in which the examination starts with longitudinal and transverse sections.

The examination is accompanied – and this repetition may be excused – by the routine positioning of the patient, with FS right and left – and are namely obligatory. Possibly this positioning is carried out in combination with respiration, and if needed, with breath-holding manoeuvres.

The examination ends with the lower abdominal sections (LAS) – they are conducted again in the supine position and serve the thorough inspection of the little pelvis.

Hereby, circumscribed selective pain information, as already mentioned, is to be given particular attention during all examination steps; especially in somewhat indolent and bearing patients – frequently diagnostically relevant circumstantial evidence is found by this (see "visual palpation").

The advantages of a systematic procedure are obvious: By the ubiquitous gravitation the densely packed organs of the upper abdomen are straightened out and depicted in a better way. In addition to this, more degrees of movement freedom are gained for the guiding of the transducer, and also complete "illumination" of the given individual status is achieved, in order to generate a real-time three-dimensional current image from the many two-dimensional individual pictures – a procedure, which is today still managed to a large extent by the cerebrum. It is more and more superseded by the electronic possibilities of three or four dimensional sonography. Time is considered here the fourth dimension.

Please note:

- ***dynamic and active examination***
- ***the patient must cooperate***
- ***pay attention to visual palpation***
- ***positioning***
- ***use real-time character***
- ***"nice" device settings***

THE TEN COMANDMENTS OF CLINICAL ULTRASOUND

One must:

1. esteem clinical ultrasound examinations, and only if necessary use other diagnostic methods alongside
2. have a clear indication for the clinical ultrasound examination (and phrase it clearly in both the medical report, as well as in front of the examined person)
3. speak with the examined person (also to know medical history and symptoms)
4. always examine systematically and make a poker face when doing so
5. always examine thoroughly and observe exactly the moving image
6. position the examined person (such as from supine position to the side)

7. let the examined person inhale and exhale
8. label the documentation
9. select the most suitable image sections, and moreover select the device settings meticulously

10. clearly separate medical findings, (judgmental) diagnosis, and individual recommendations from each other

3 Dimensions and Numbers

In our western way of thinking we like to recognize only measurable and countable "facts" – a typical western singularity, which has without doubt advanced our cultural understanding enormously – and at the same time is a behavioural pattern, which of course also has its natural limits. When contemplating the limits of "exact" measurements, it comes to mind that they are strictly speaking only approximations (as it were approximations of the first degree) that are possible.

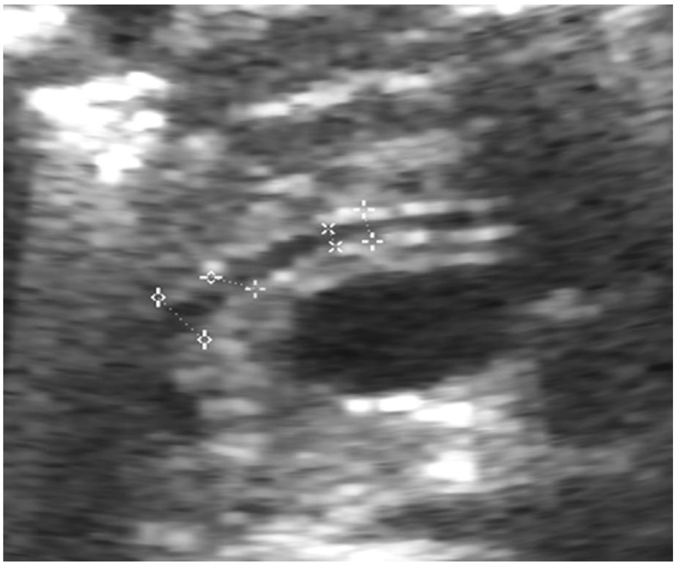


Fig. 3.01 Problems with measuring the duct diameter for significant dilatations, from left to right: about 6.5 (additionally measurement mistakes by wrong setting of measurement points), 2 and 3 mm diameter – what is the "truth"? Normal splenic vein; UAS transverse

With respect to real circumstances, for example in a polymorph organ such as the liver or gallbladder, such measurements frequently fail. The more so, as we refer to the length or width of an organ and actually mean the volume. It has to be conceded, that not all circumstances are measurable – the more practical experience with the ultrasound, the more frequently it can be done without the seemingly so tempting exactness of counting and measuring: for the benefit of a faster visual assessment. If there is a normal finding or not, as a rule this visual assessment is sufficient.

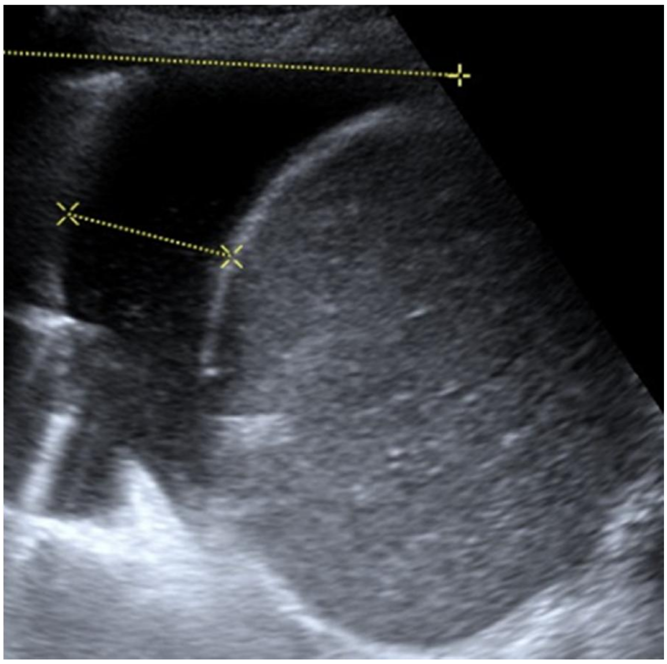


Fig. 3.02 Approximate measurement of a pleural effusion volume (actually the visual assessment of a few or moderate to very many millilitres is sufficient); high FS right

Please note:

- ***do not overvalue, but also not undervalue numbers and dimensions***
- ***they always should be understood as a first approximation***
- ***always correlate with clinical picture***

4 Individual Organs and Techniques

4.1 Preliminary Remarks

The imaging of individual organs may be difficult – this problem is to be elucidated in the following. In general it is valid, that everything in the abdomen can be observed satisfactorily, there are only rare exceptions (e.g. ovaries) which contradict this rule.

In any case, findings that are always preceded with a note regarding supposedly poor imaging ("soundability") are to be taken with a certain amount of scepticism.

Abundant accumulations of gas can be easily moved aside or compressed, whereby the organs and regions of interests appear even better in the focus area of the transducer, or are to be circumvented by changing position. Pathological conditions, such as e.g. an obstruction can improve imaging markedly.

Generally, if possible, it is to be switched to high-resolution (high-frequency) transducers, in order to allow optimal use of all position and compression possibilities.

Also unusual regions, e.g. adrenal glands or testicles, are to be equally included in the examination as the very efficient section patterns perineal, at the extremities, or thoracal. Even cervical soft tissue is, with appropriate indication, well accessible by ultrasound.

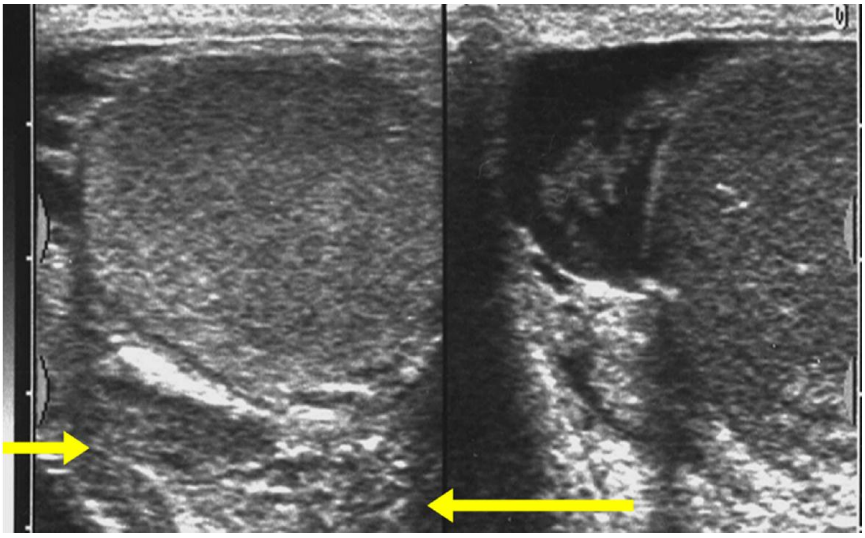


Fig. 4.1.01 a, b	Epididymitis right (arrows), inflammatory fluid accumulation, inconspicuous testicles; high-frequency transducer

Fig. 4.1.02 Foetus, LAS longitudinal

General obstacles are the sometimes only hardly recognizable, inverted positions (situs inversus) and an otherwise unusual anatomy.

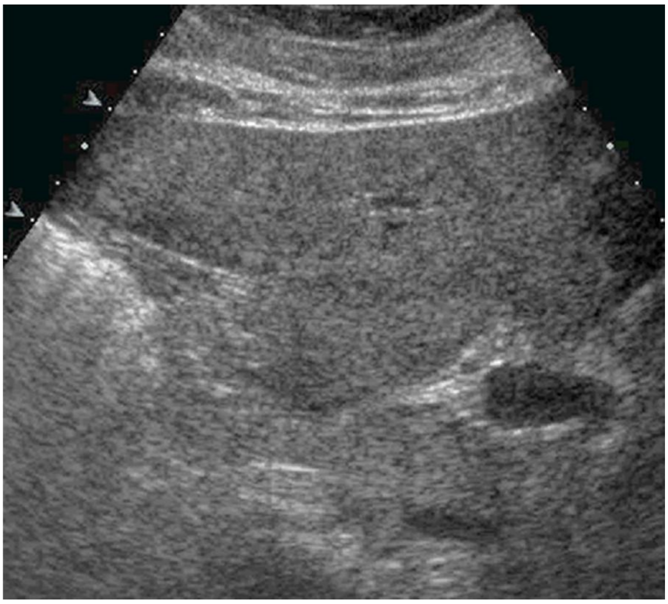


Fig. 4.1.03 Genuine inverted position; UAS transverse

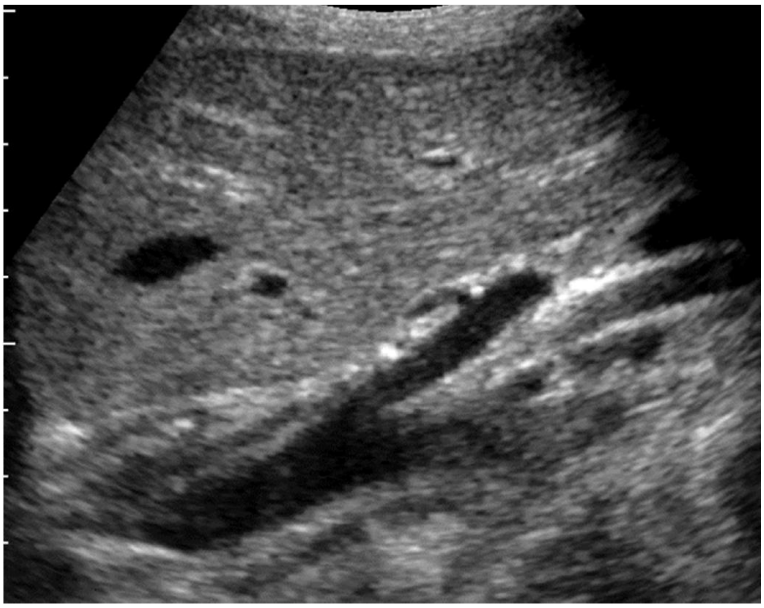


Fig. 4.1.04 Normal LS with terminal oesophagus, left gastric artery, diaphragm, as also superior mesenteric vein and artery in front of the aorta

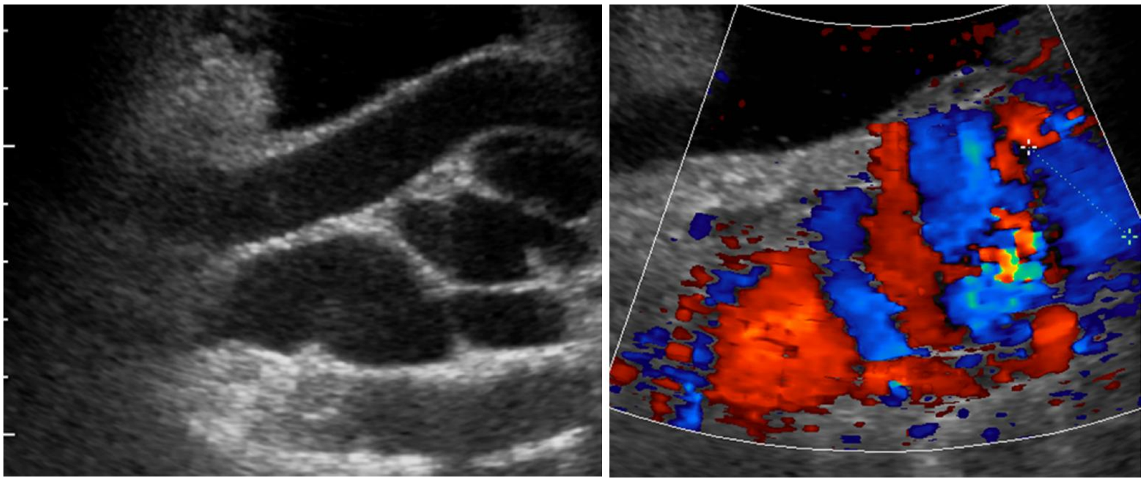


Fig. 4.1.05 a, b Subcaval variceal convolute with portal hypertension; FS right, with CCDS (b)

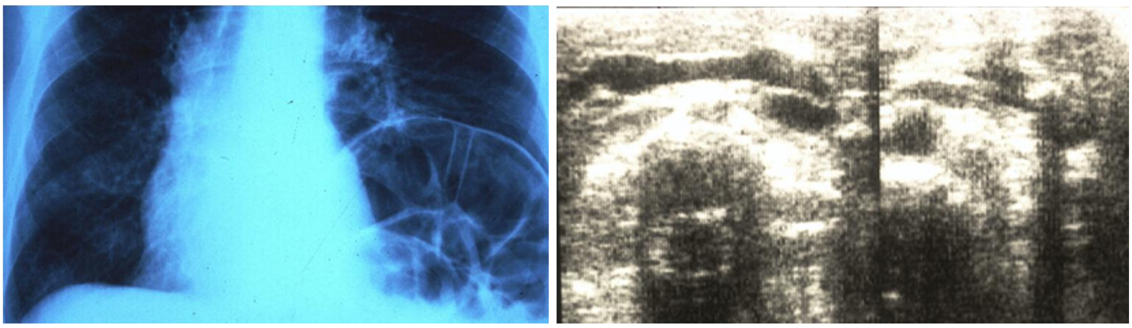


Fig. 4.1.06 a, b Difficult choledocholithiasis with congested hepatic bile duct and with unusual shift to the left (upper image half) of the upper abdominal site as a result of a previously conducted phrenic nerve exheresis decades ago; normal spinal

cord (b); recovery by EPT; longitudinal and transverse sections. The image quality in b and c corresponds to the possibilities of the date taken (late 1970ies).

Here, sometimes imaginative and unusual deductions are necessary.

Everything representable should always be searched using the adequate transducer, and if necessary reference should be made to the examination obstacles in the medical report.

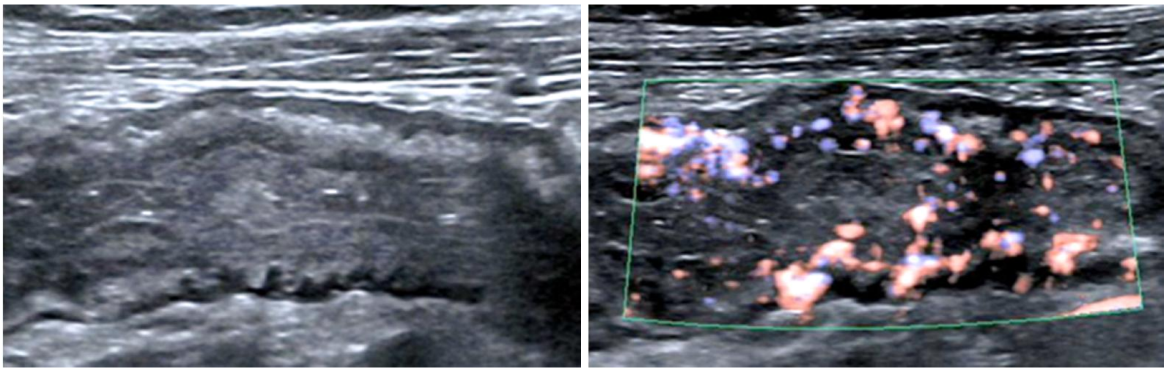


Fig. 4.1.07 a, b High-resolution (5 MHz) transducer, normal small intestinal perfusion; LAS transverse (b with CCDS)

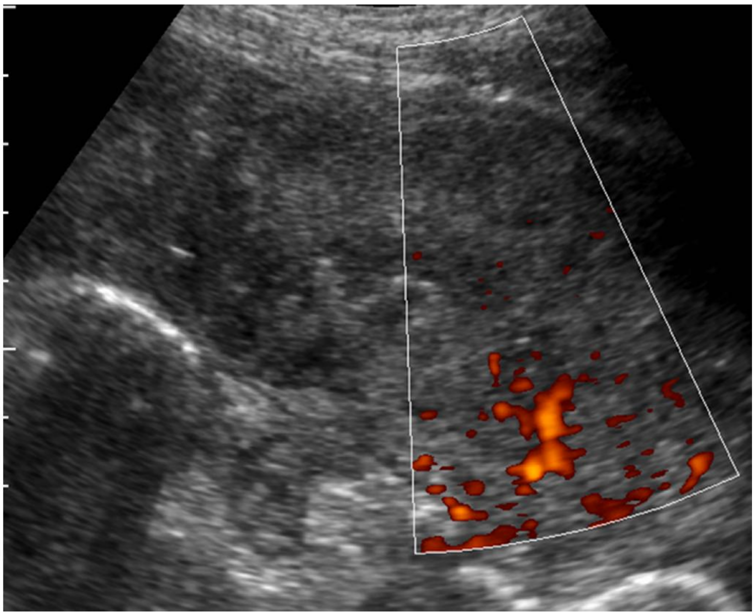


Fig. 4.1.08 Large upper abdominal tumour (sarcoma?); SCS left

Please note:

- ***use variation possibilities of section patterns***
- ***use also unusual sections***
- ***let patient breathe***
- ***pay attention to unusual anatomies***
- ***use associative phantasy – not too much, but also not too little***

4.2 Blood Vessels

The knowledge of their pathways is attributed justifiably crucial importance. It is particularly valid for the macroscopic perception of still accessible vessel ramifications of the celiac artery, and for numerous vessel segments of the arterial, venous, and also portal venous segment including its diverse variations of the norm, and the clearly pathological, which are named here only exemplarily.

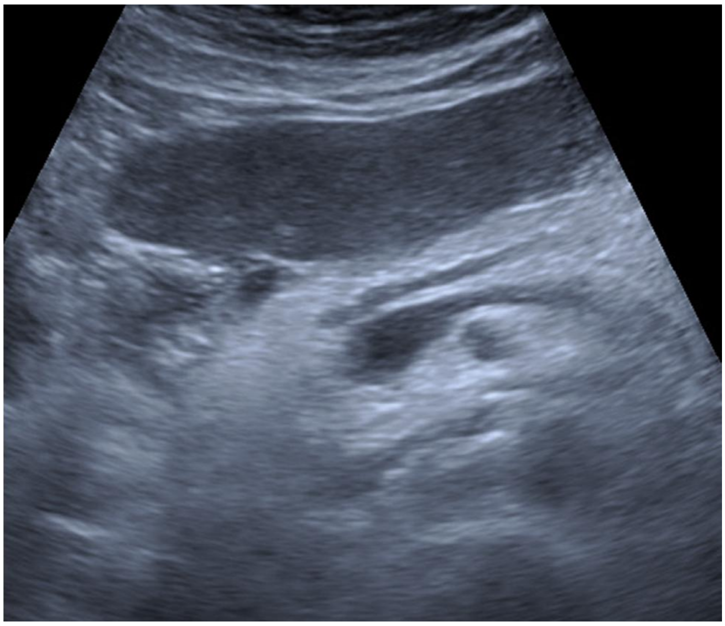


Fig. 4.2.01 Slightly congested pancreatic duct (which can also be taken as a vessel), age-related atelectasis of the hepatic artery; panaceas head and splenic vein including confluence normal with age-related typically increased reflexibility ("age adiposity"); in deep inspiration high setting in UAS transverse

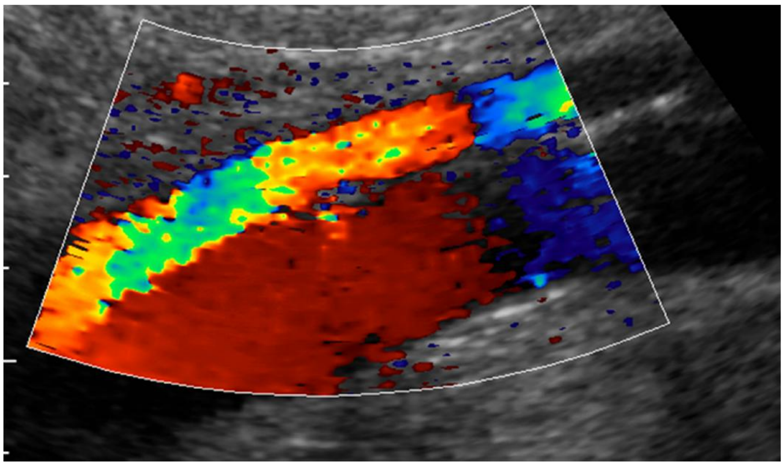


Fig. 4.2.02 Superior mesenteric artery and aorta, narrow normal finding; UAS longitudinal

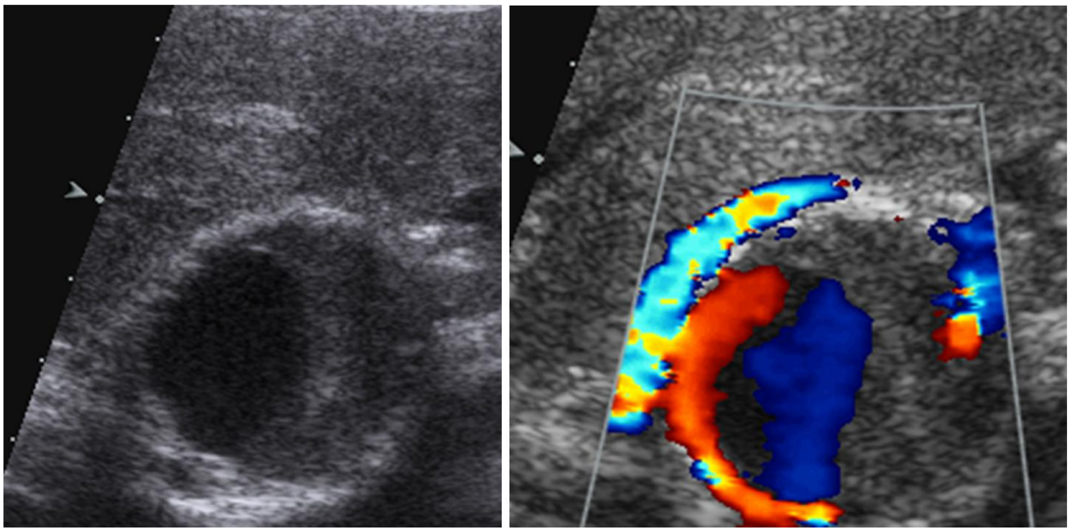


Fig. 4.2.03 a, b Acute thrombotic occlusion of aorta (supra-renal) with compression of inferior vena cava (b); UAS transverse, CCDS (b)

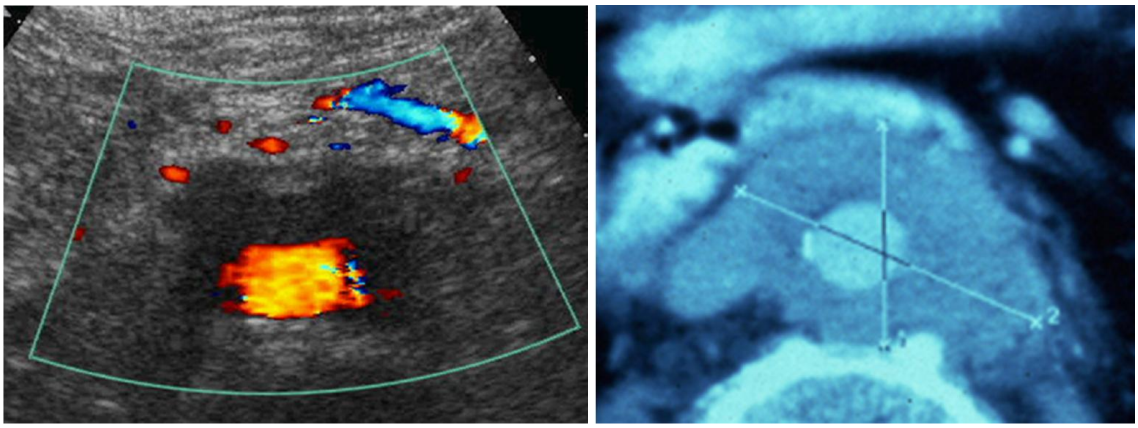


Fig. 4.2.04 a, b Ormond's disease with "perimeter wall" of aorta; UAS transverse (a with CCDS)

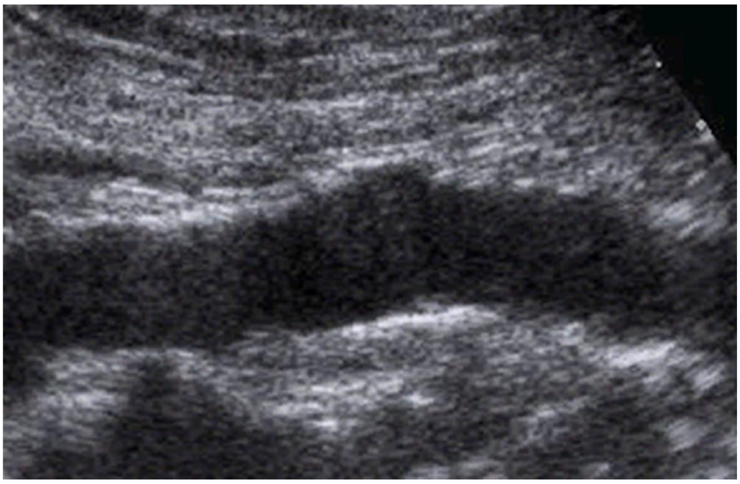


Fig. 4.2.05 Sclerotic abdominal aorta; LS

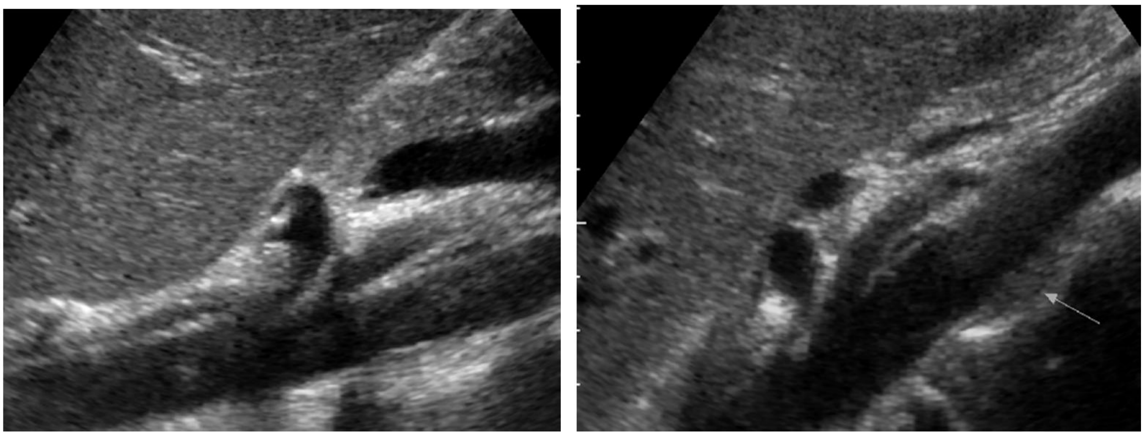


Fig. 4.2.06 a, b Classic median longitudinal sections with the usual numerous normal details (a aorta with hepatic (ventral), gastric and superior mesenteric arteries (close together), diaphragm and terminal oesophagus (before its diaphragm passage) in truncated sections, liver, pancreas and splenic vein also truncated; b pathological calcification of the trunk as well as perivascular lymph nodes (arrow in b; two different patients); LS

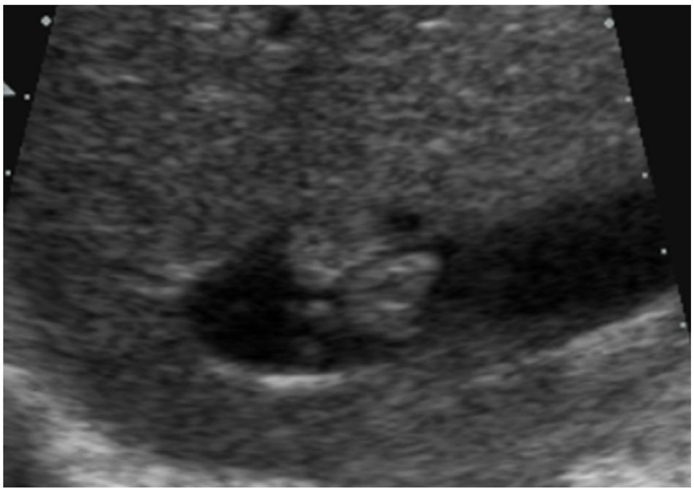


Fig. 4.2.07 Vena cava invasion (tumour thrombosis) by a malignant tumour; LS

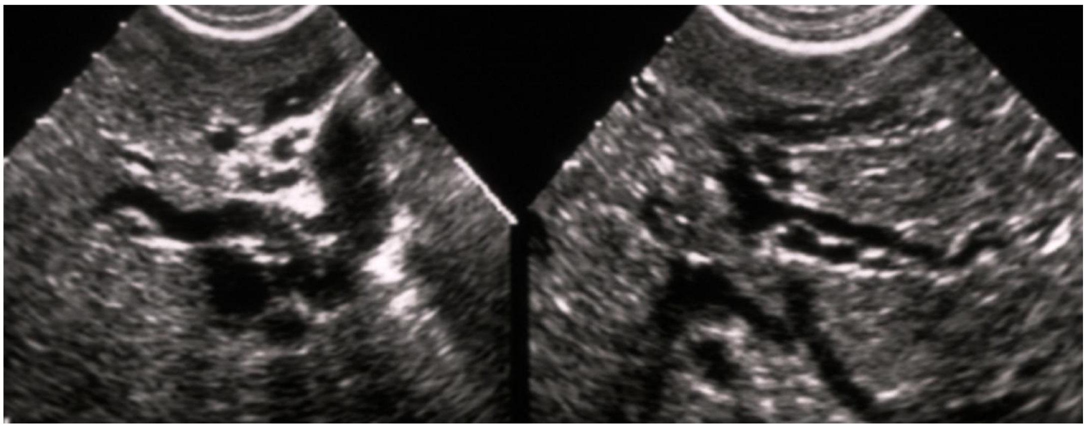


Fig. 4.2.08 a, b Accentuated artery branches, no cholestasis (clinical malformations typical for hereditary haemorrhagic telangiectasia, also known as Osler-Weber-Rendu disease); SCS right

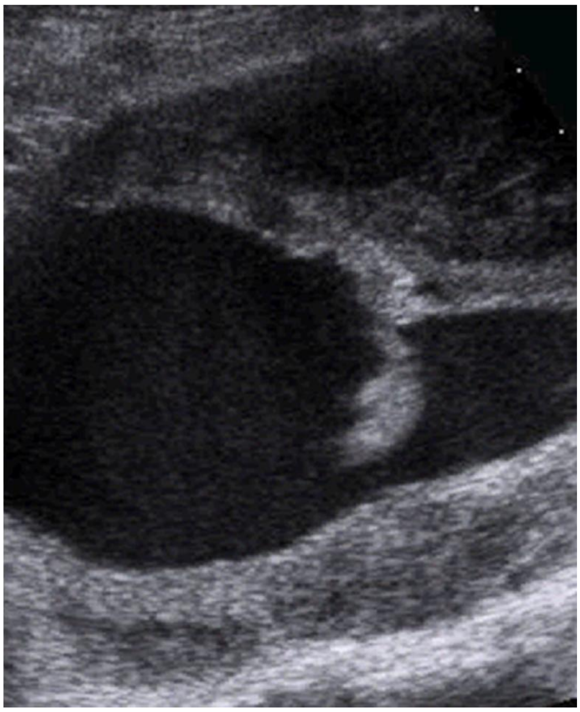


Fig. 4.2.09 Ruptured aortic aneurysm (leakage left in patient), unspecific lymph nodes; UAS transverse

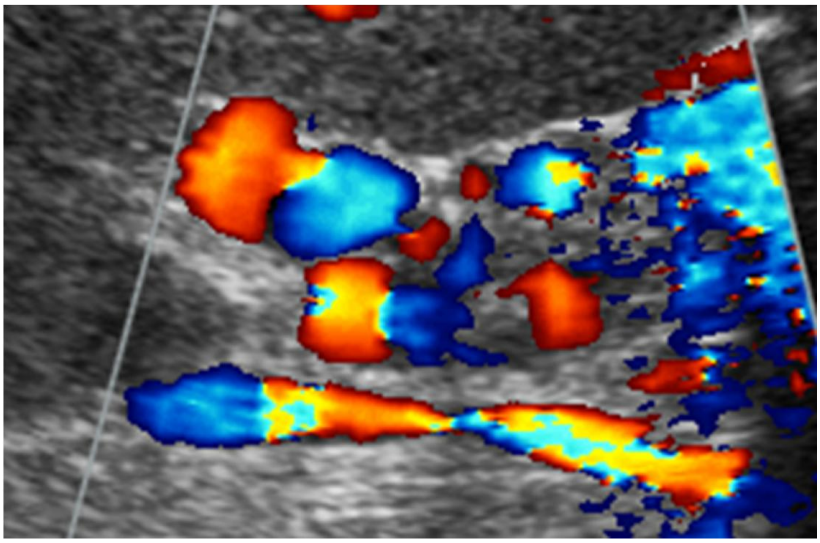


Fig. 4.2.10 Cavernous portal vein transformation; FS right

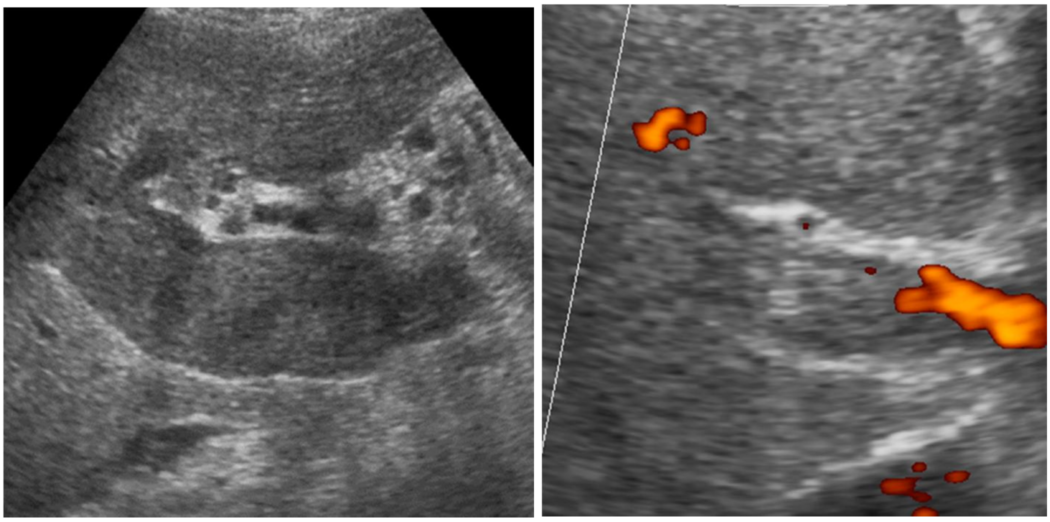


Fig. 4.2.11 a, b Portal vein tumour thrombosis, interjacent crossing of right hepatic artery branch, common bile duct only in its pre-papillary pathway of normal size (a) or parietal (b) with residual flow truncated (two different cases); FS right, CCDS (b)

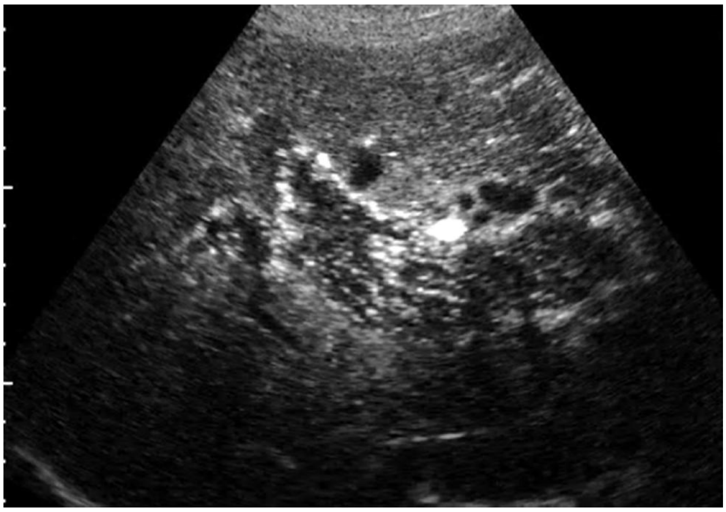


Fig. 4.2.12 Tumour thrombus invasion of an HCC; FS right

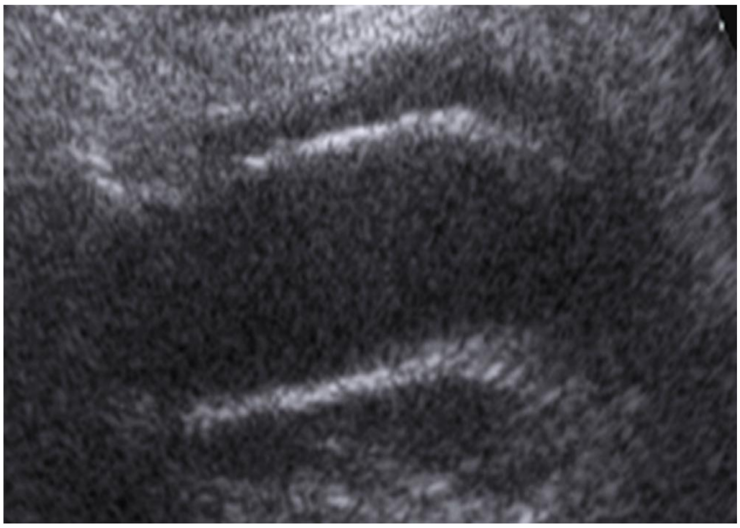


Fig. 4.2.13 Aneurysm sack remaining around prosthesis; UAS longitudinal

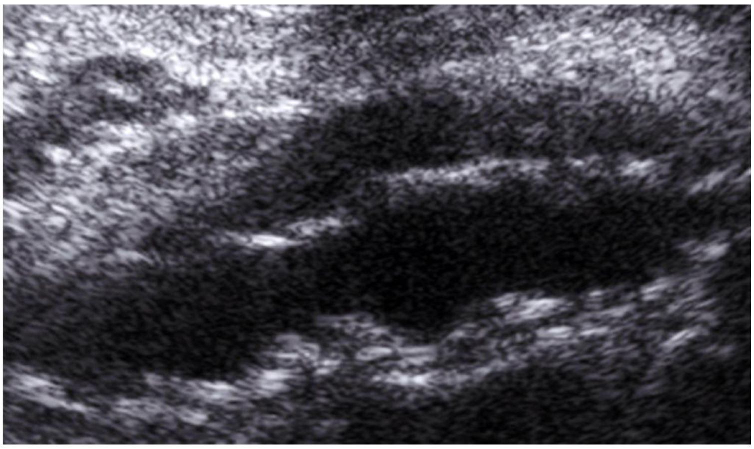


Fig. 4.2.14 Membranous dissection of aortic intima (clinical conservative observation); UAS longitudinal

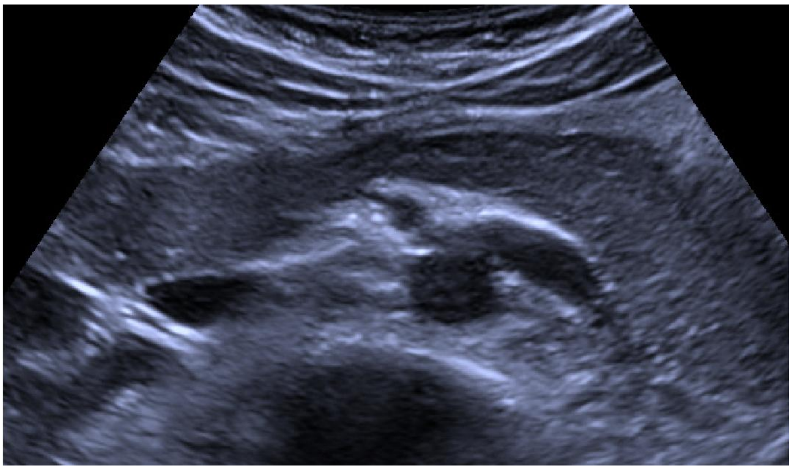


Fig. 4.2.15 "Nutcracker" syndrome with congestion of left renal vein; normal superior mesenteric, hepatic, renal arteries, aorta, as well as inferior vena cava; UAS transverse

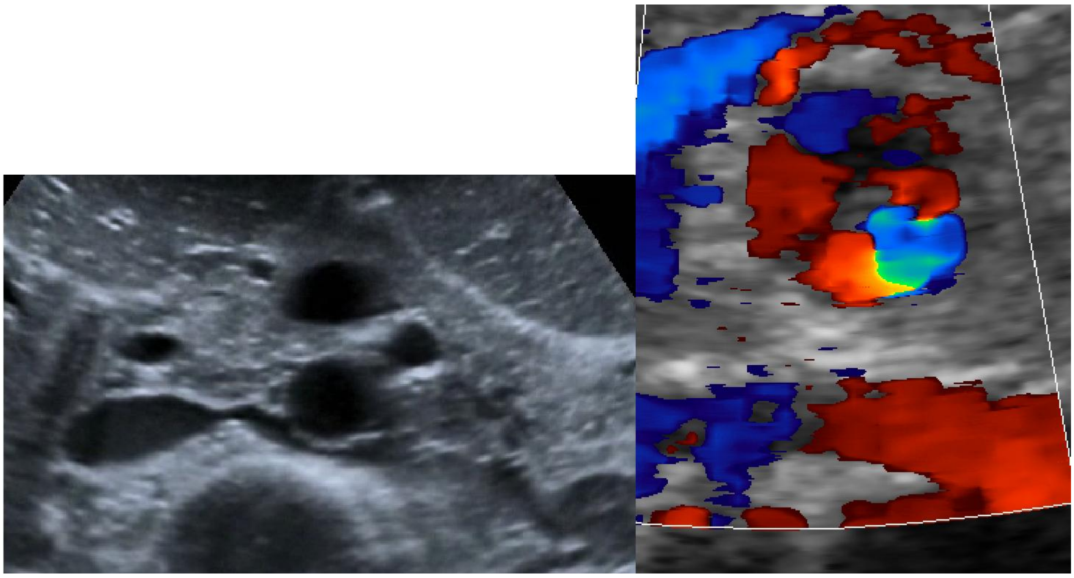


Fig. 4.2.16 a, b Atypical pathway of left renal vein dorsal of aorta; UAS transverse (right magnified with CCDS, two different patients)

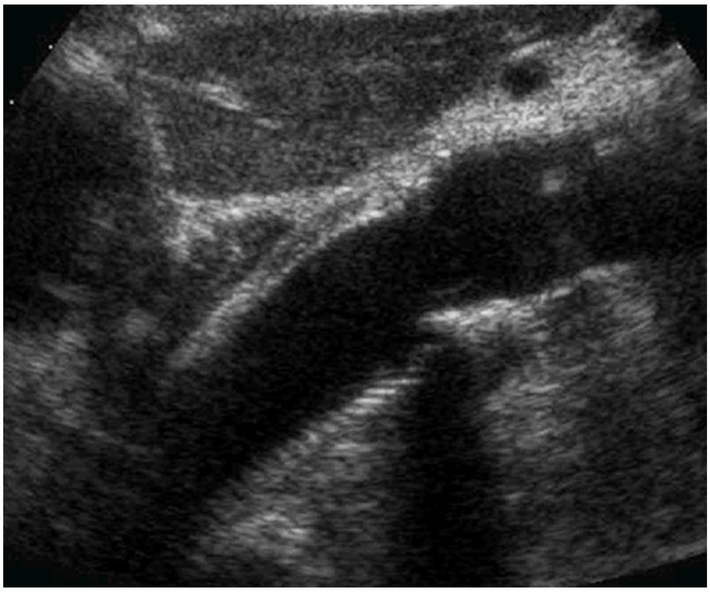


Fig. 4.2.17 Thoracal aortic prosthesis; UAS longitudinal

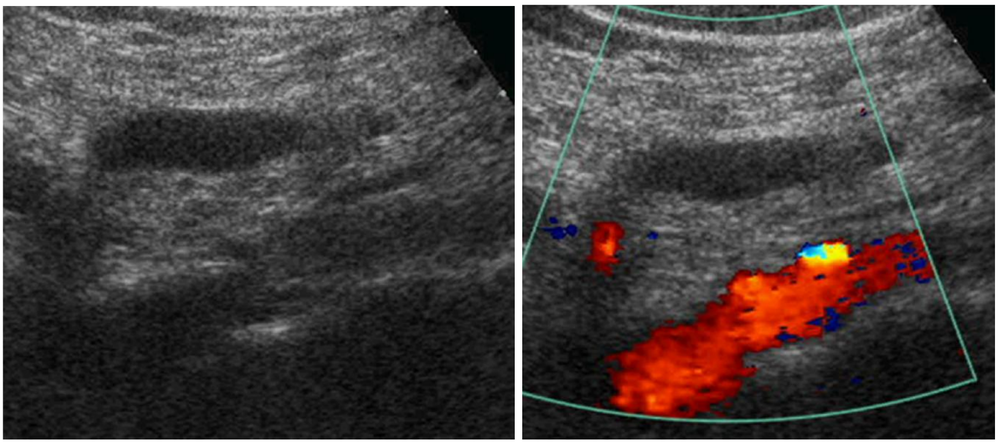


Fig. 4.2.18 a, b Occlusion of superior mesenteric vein; LS with CCDS and compression (b)

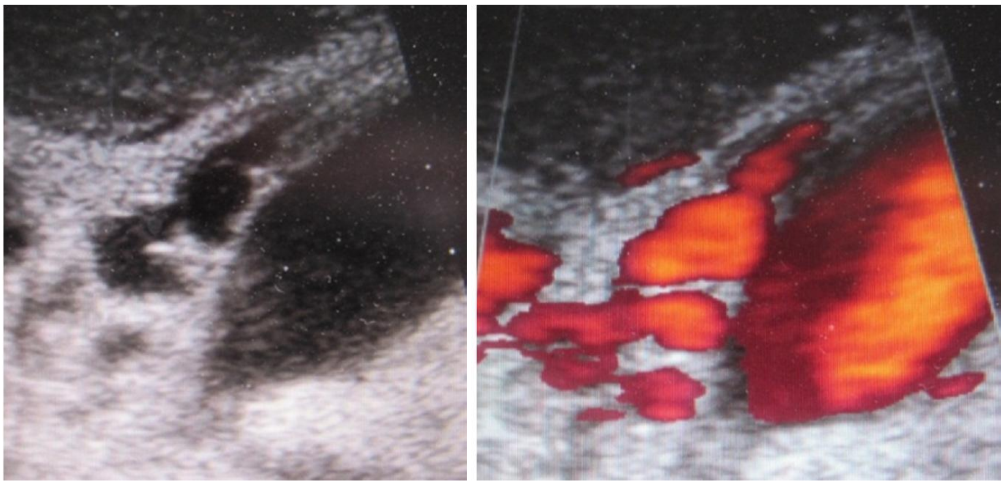


Fig. 4.2.19 a, b Rare case of trans-cutaneously verifiable oesophagus variceal convolute; epigastric cross-sections (b with CCDS)

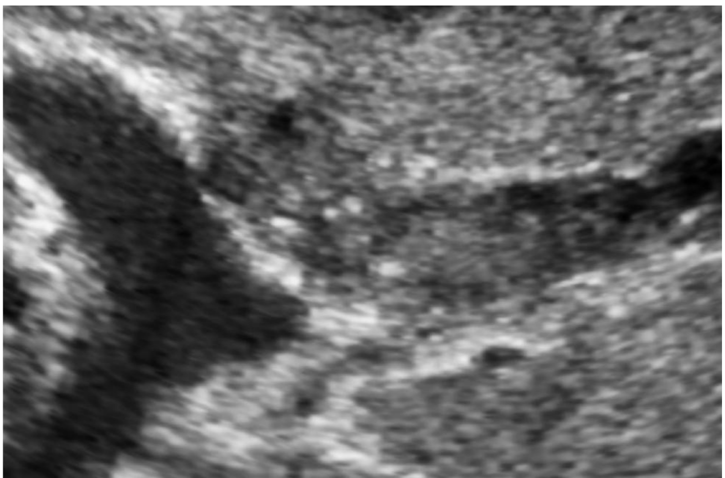


Fig. 4.2.20 Segment III (clinical PSC), ramification with biliary sludge; UAS transverse

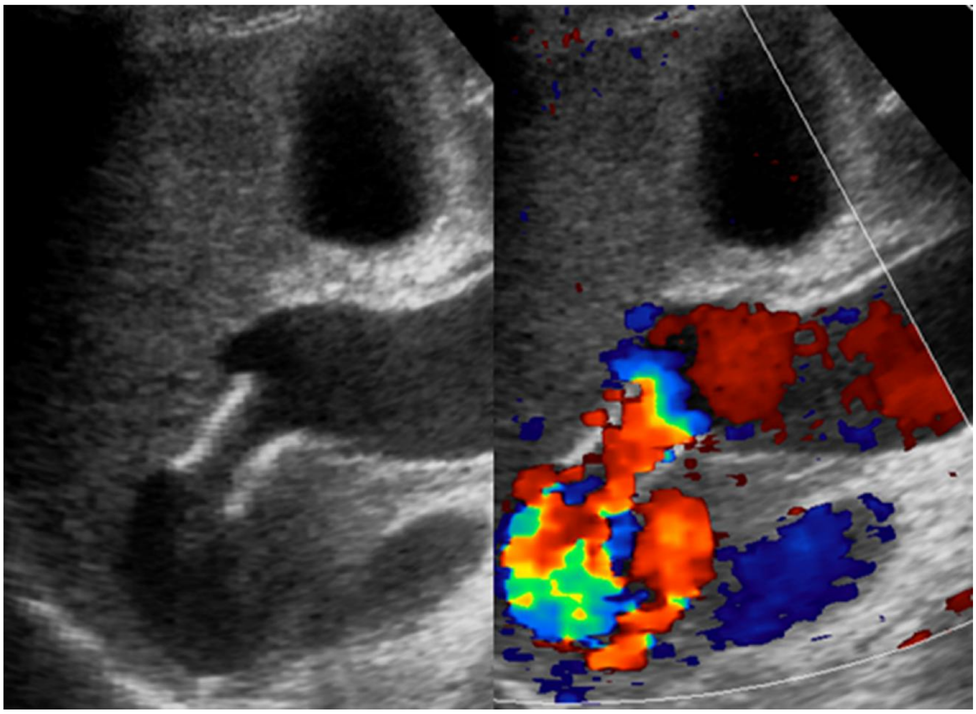


Fig. 4.2.21 a, b Normal TIPS function; FS right (b with CCDS)

Fig. 4.2.22 Congested and minimally pulsating inferior vena cava and hepatic veins of a diffusely proliferated reflexive liver ("fatty liver"); SCS right

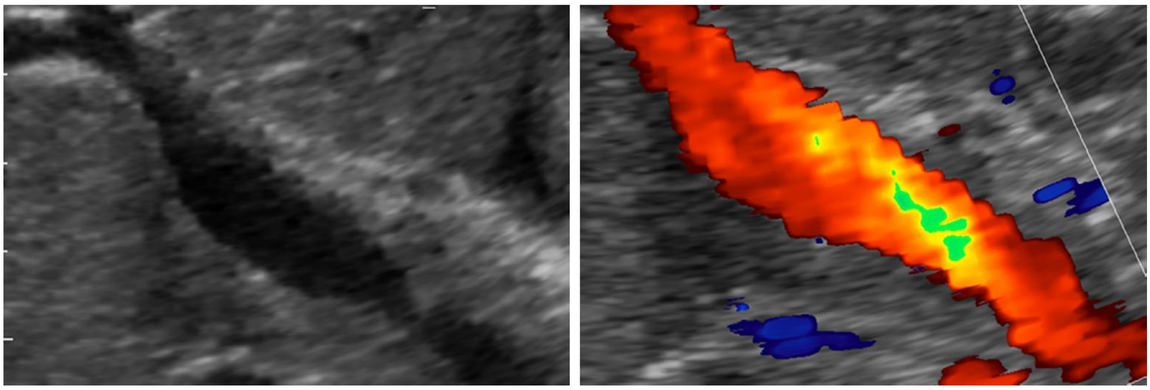


Fig. 4.2.23 a, b Breast cancer metastases indenting and infiltrating portal vein; FS right (b with CCDS)

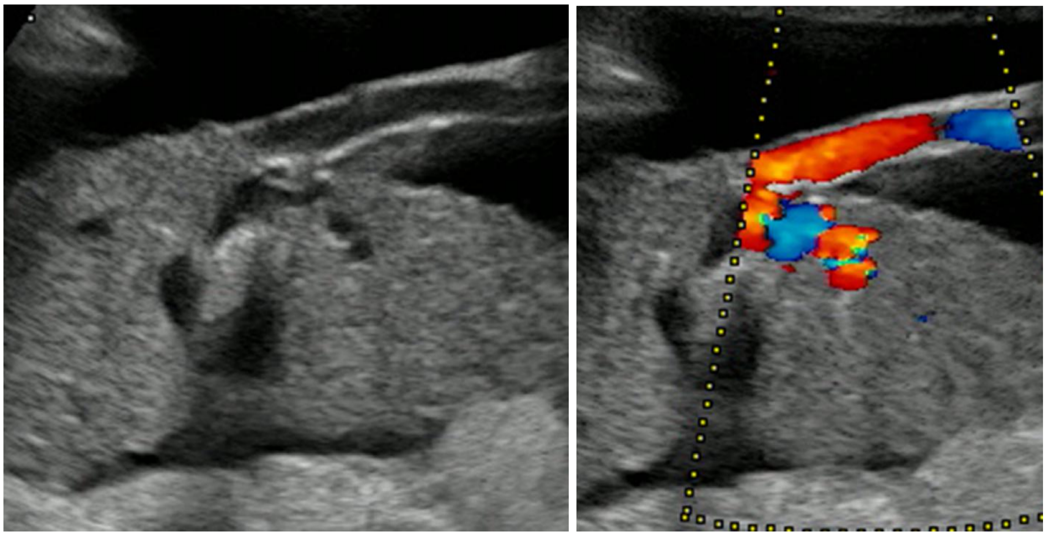


Fig. 4.2.24 a, b Portal hypertension with liver cirrhosis (so-called Cruveilhier-von-Baumgarten syndrome); UAS longitudinal (b CCDS)

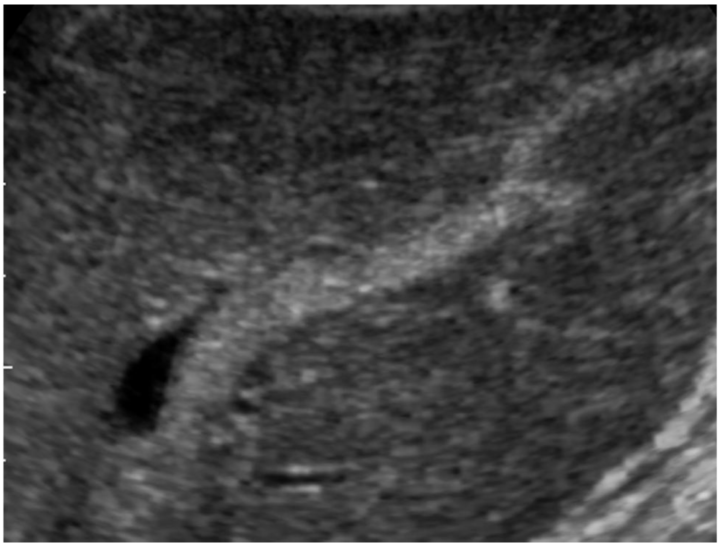


Fig. 4.2.25 Sludge in peripheral bile duct ramifications; SCS right

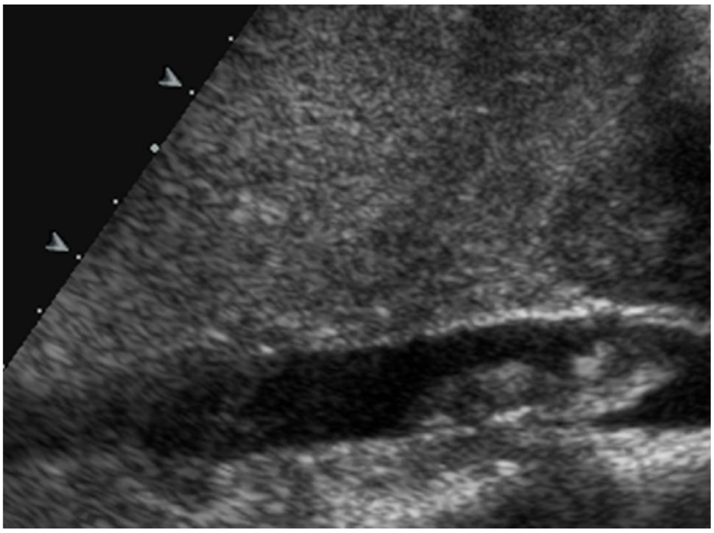


Fig. 4.2.26 Thrombosis in inferior vena cava; UAS longitudinal

Please note:

- ***look closely and sufficiently long***
- ***observe the same region from several section planes***
- ***let the patient breathe***
- ***positioning***
- ***compression***

4.3 Liver

A large, comparatively almost huge organ, which can easily be found and examined by ultrasound – one would think. As a general rule this is correct, but caution and thoroughness are warranted: Besides shape variations, the liver often has innocuous focal lesions, which for their part can hide pathological structures – circumstances that are particularly well accessible with CM sonography.

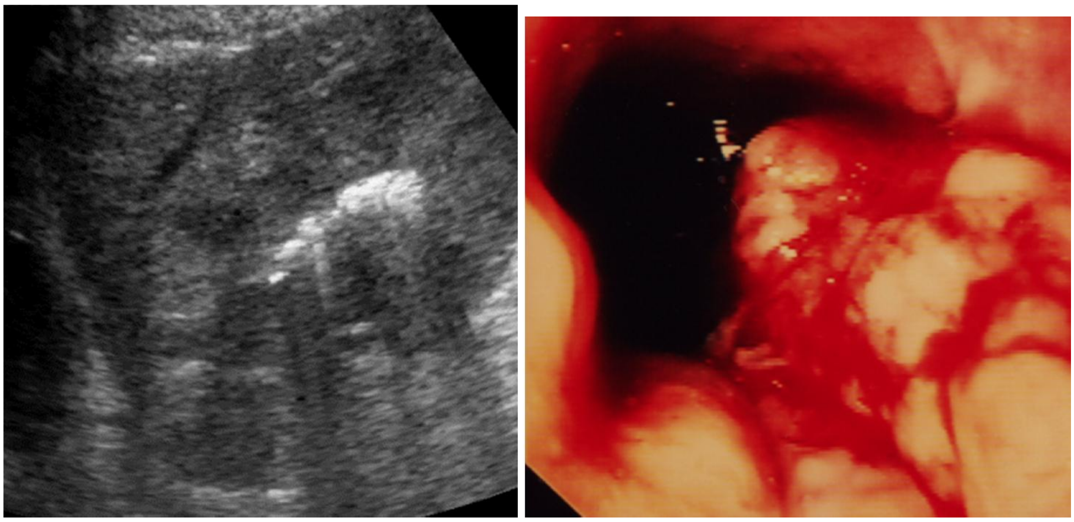


Fig. 4.3.01 a, b No focal hepatic lesions with central abscess formation (CT false diagnosis), but gastric Linitis plastica (Brinton's disease), evident by respiratory motility; SCS (a), and endoscopic view (b)

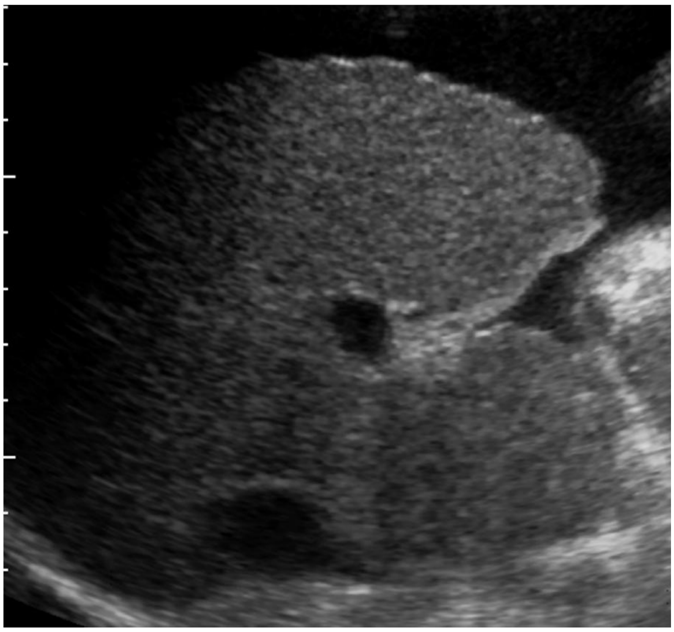


Fig. 4.3.02 Micronodular liver cirrhosis with misconfiguration on lower rim and accentuated segment I; UAS longitudinal

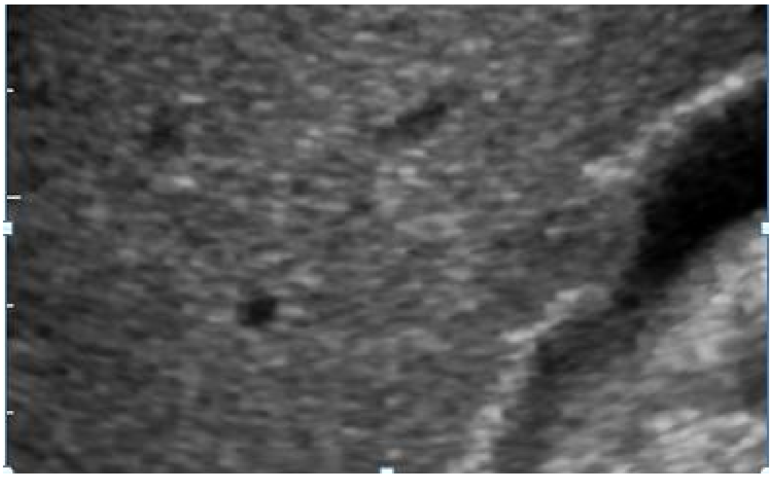


Fig. 4.3.03 Liver cirrhosis in hemochromatosis, with a nodule impressing gallbladder

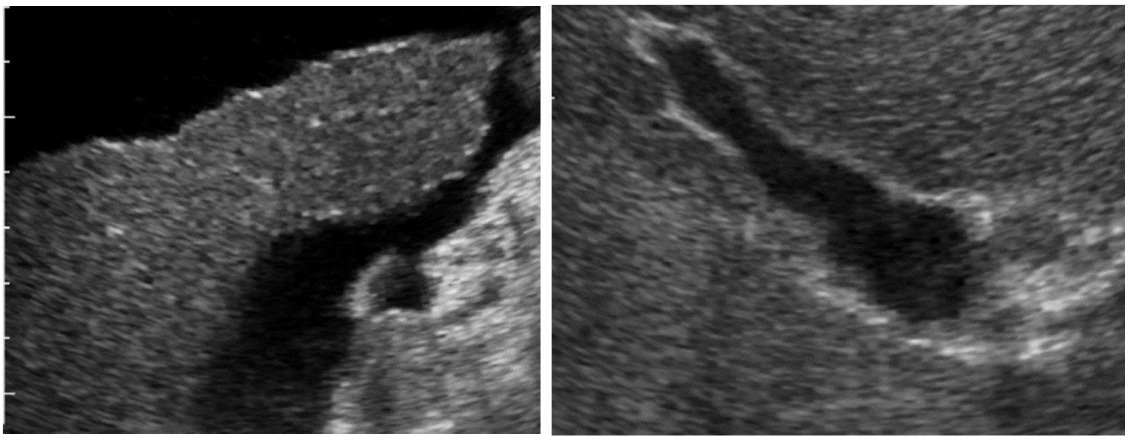


Fig. 4.3.04 a, b Hepatic cirrhosis misconfigurations are particularly marked at high-impedance bordering areas; LS (a), SCS (b)

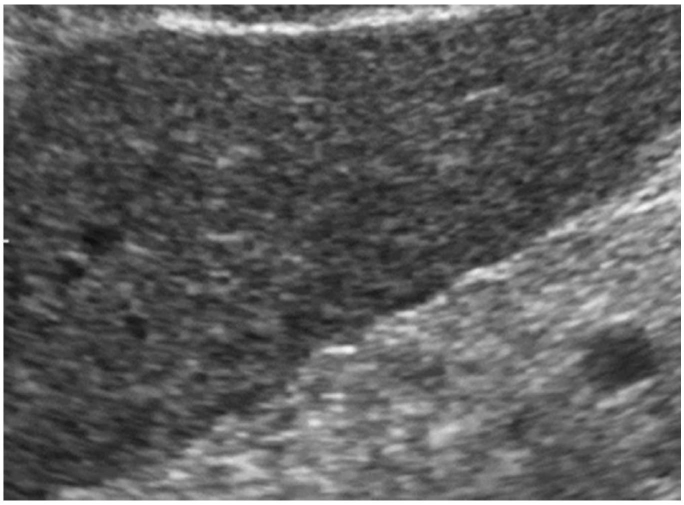


Fig. 4.3.05 Cirrhosis typical nodes with well visible boundaries to their high-impedance environment (above), and somewhat less marked differentiability with bordering intestinal loops (two different cases); SCS right

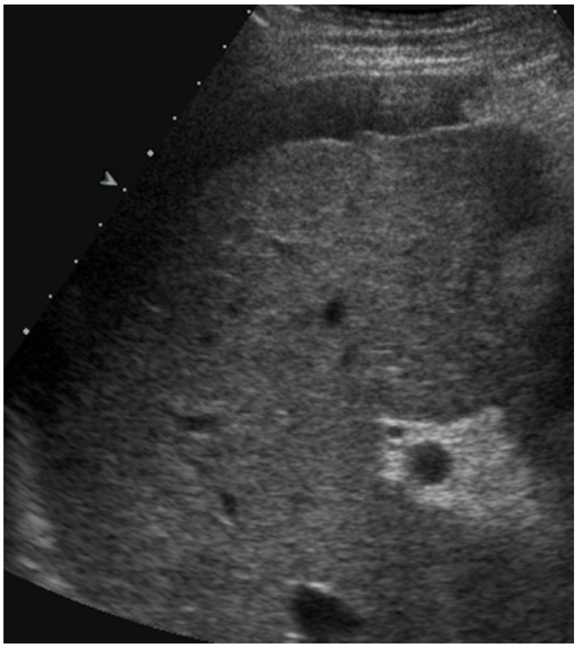


Fig. 4.3.06 Medium-sized nodular decompensated liver cirrhosis, ascites; FS right

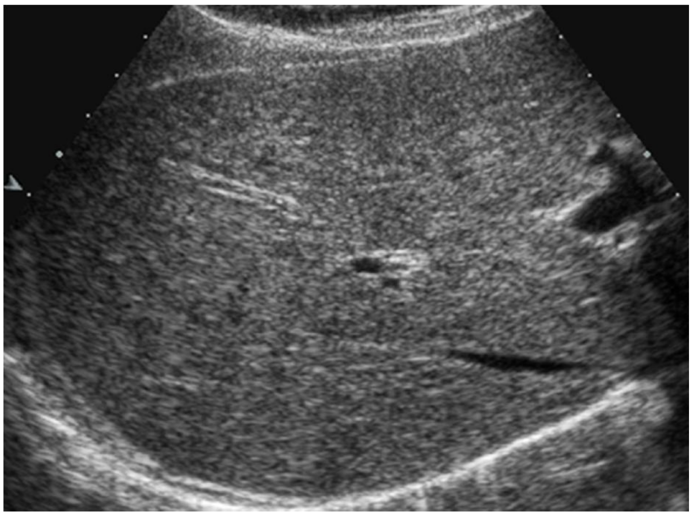


Fig. 4.3.07 PSC known for many years with 5-fold elevated alkaline phosphatase, seemingly normal aspect; SCS right

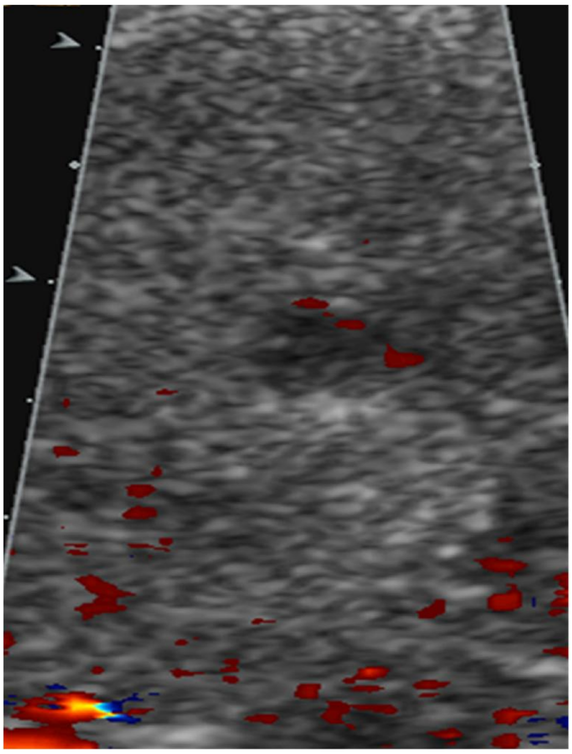


Fig. 4.3.16 Hepatic FL with poor central echo in segment II (most likely corresponding to a focal nodular hyperplasia (FNH)); SCS right

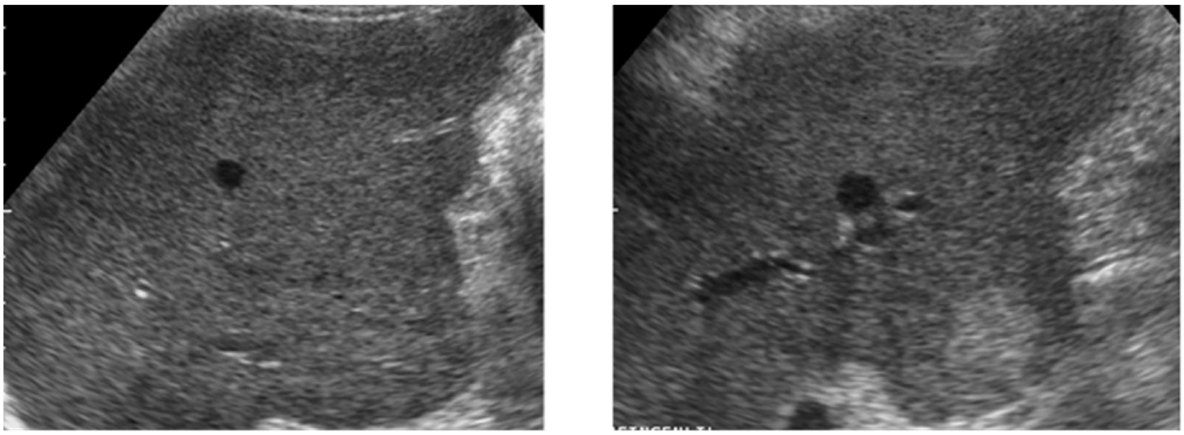


Fig. 4.3.17 a, b Accessory liver lobe with FL (probably minor haemangioma) in a "fatty liver" (somewhat condensed texture); SCS right

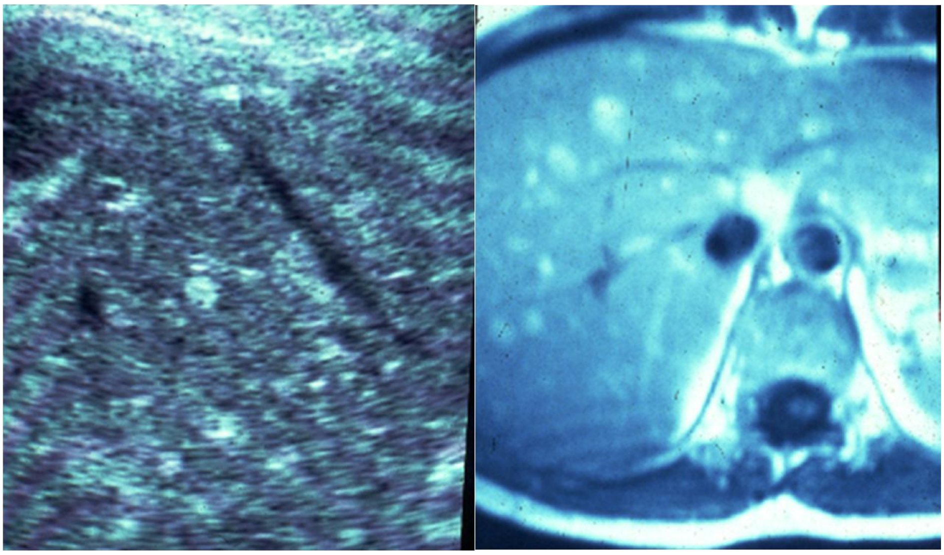


Fig. 4.3.18 a, b Apparently multiple haematomas – historically known however multi-focal HCC with aortic stenosis; SCS (a)

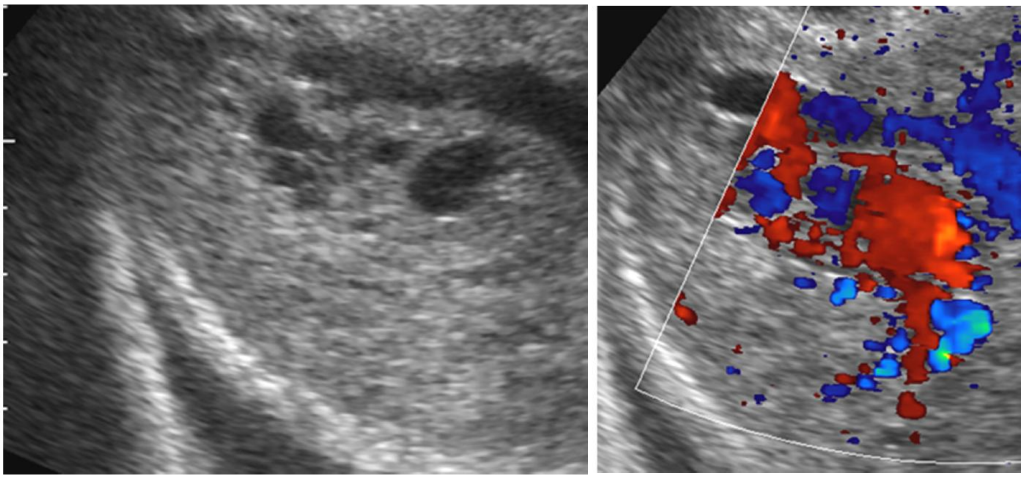


Fig. 4.3.19 a, b Hepatic involvement in Osler-Weber-Rendu disease (b) with CCDS, (a) with small pleural effusion; SCS

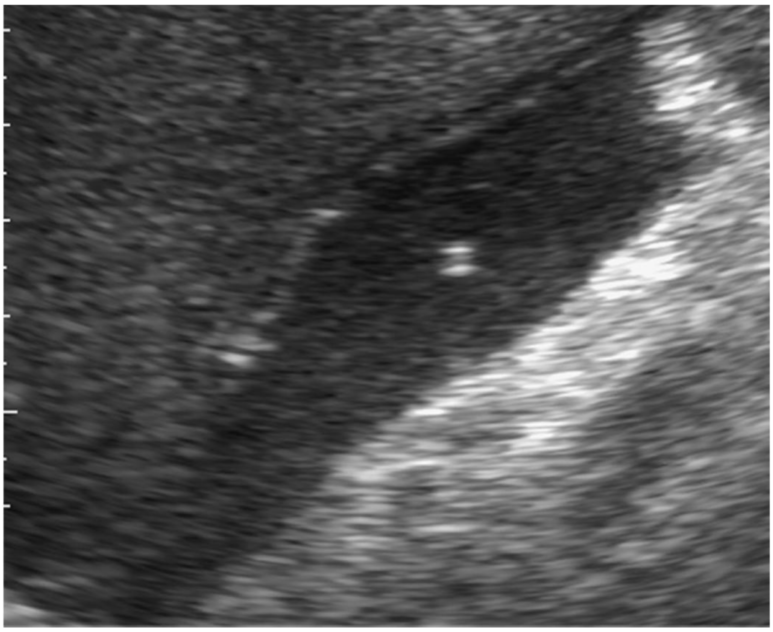


Fig. 4.3.20 Fine needle tip during puncture of a subhepatic abscess a few days after cholecystectomy, UAS longitudinal


Fig. 4.3.21 FNP of a subhepatic space occupation; FS right

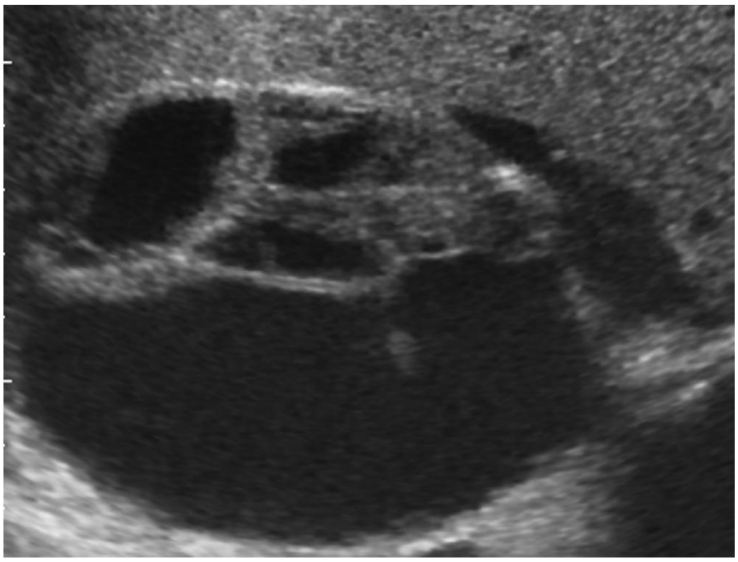


Fig. 4.3.22 Vital Echinococcus focus in the liver with daughter cysts, FS right

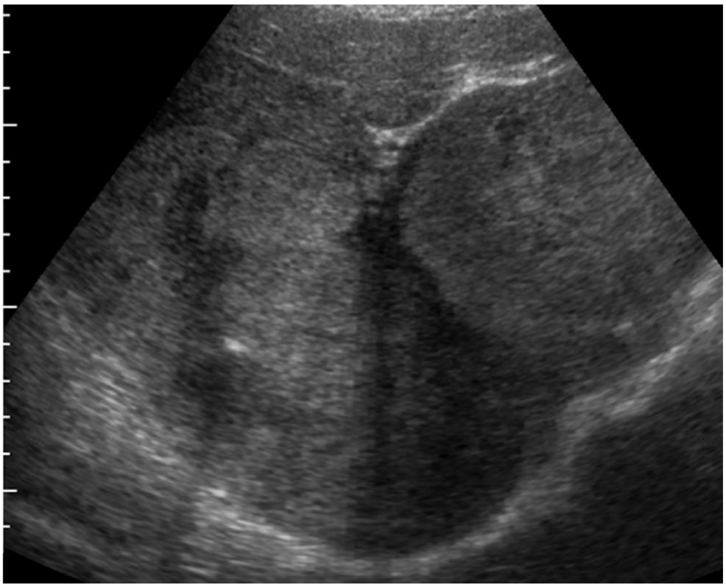


Fig. 4.3.23 Probably harmless giant haemangioma in a healthy young female patient (clinically “only” check-up with consistent findings over the years); FS right

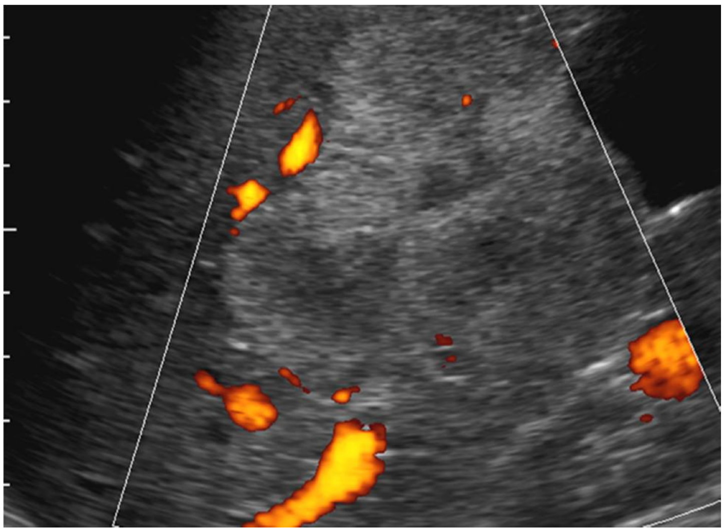


Fig. 4.3.24 Big liver haemangioma; FS right with CCDS

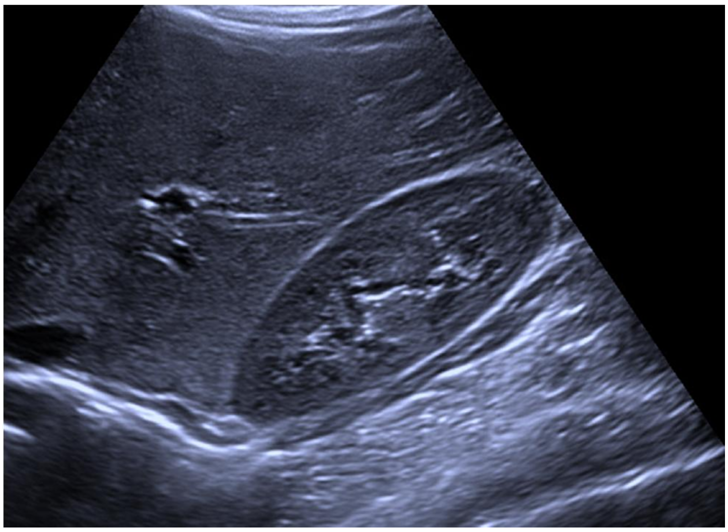


Fig. 4.3.25 Normal iso-reflexibility of the liver relative to kidney

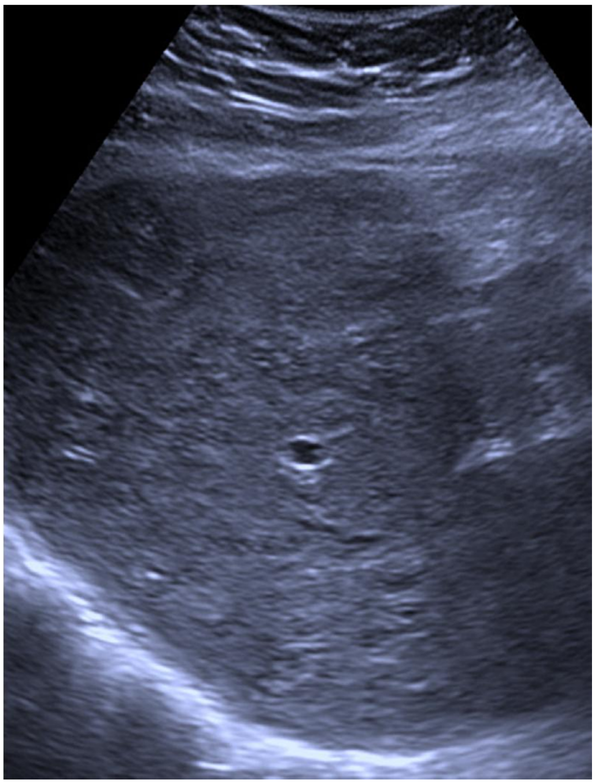


Fig. 4.3.26 Multiple probably malign FL of the liver, SCS

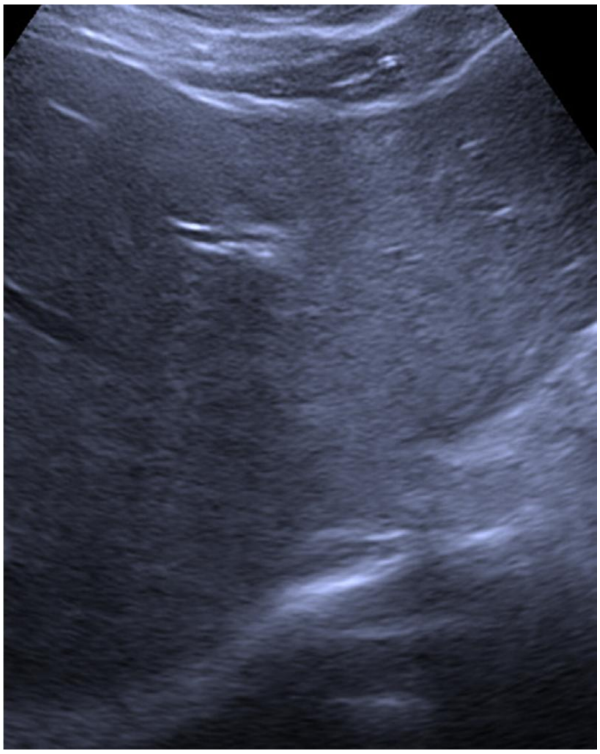


Fig. 4.3.27 Local fatty changes; UAS transverse

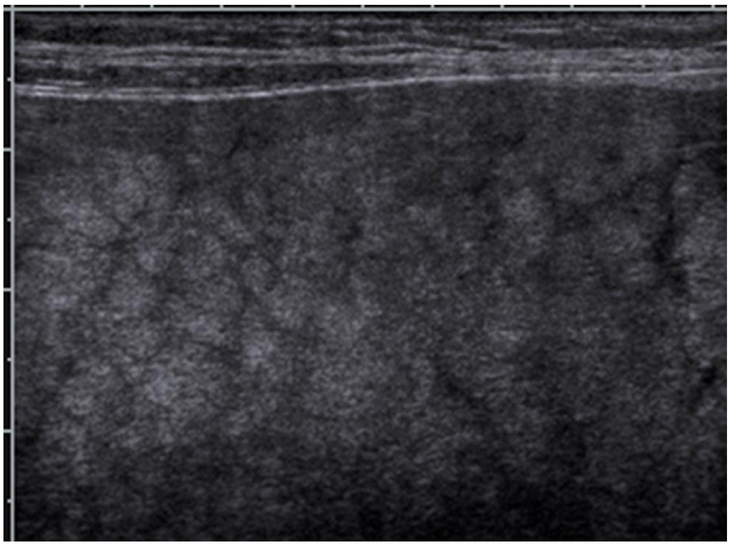


Fig. 4.3.28 Peculiarly spotted liver picture; dramatic clinical findings (alcoholic liver failure; death); SCS right (with 5 MHz transducer)

Fig. 4.3.29 FL also ultimately seen as haemangioma; SCS right

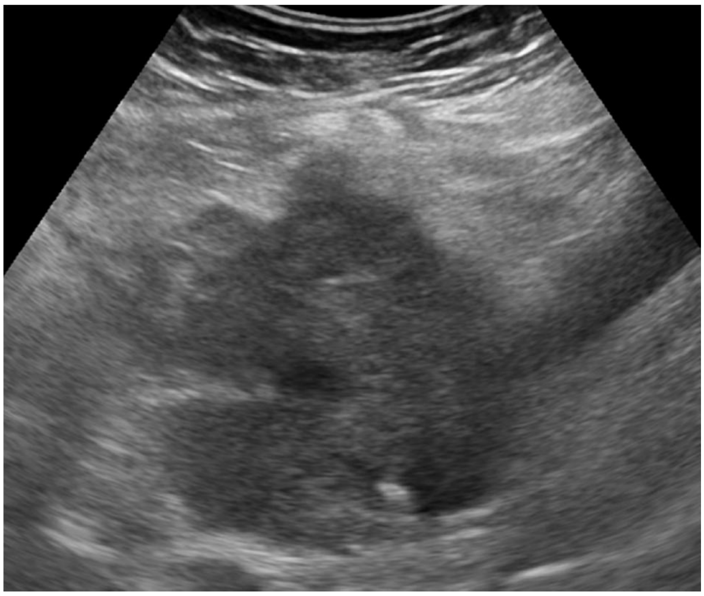


Fig. 4.3.30 Pancreas head tumour; LS right

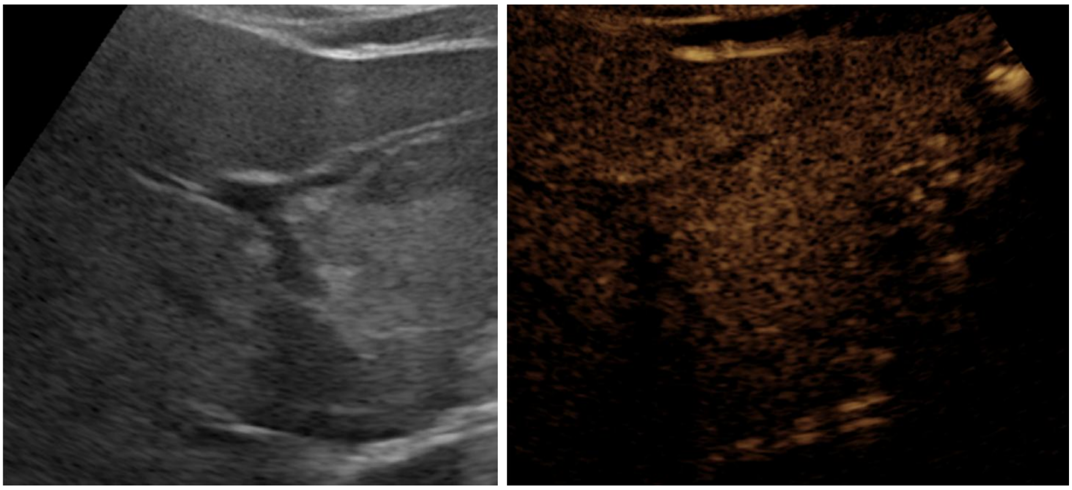


Fig. 4.3.31 a, b FL ultimately seen as haemangioma (a); SCS (b with CM)

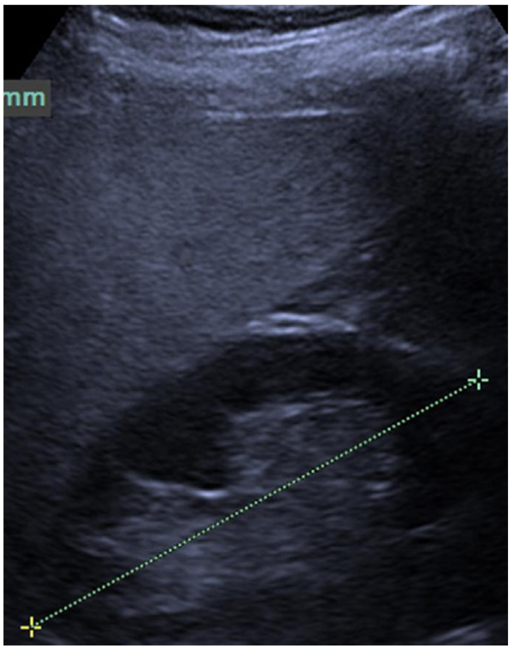


Fig. 4.3.32 Markedly increased reflexibility of liver parenchyma relative to kidney echogenicity (“fatty liver”); FS right

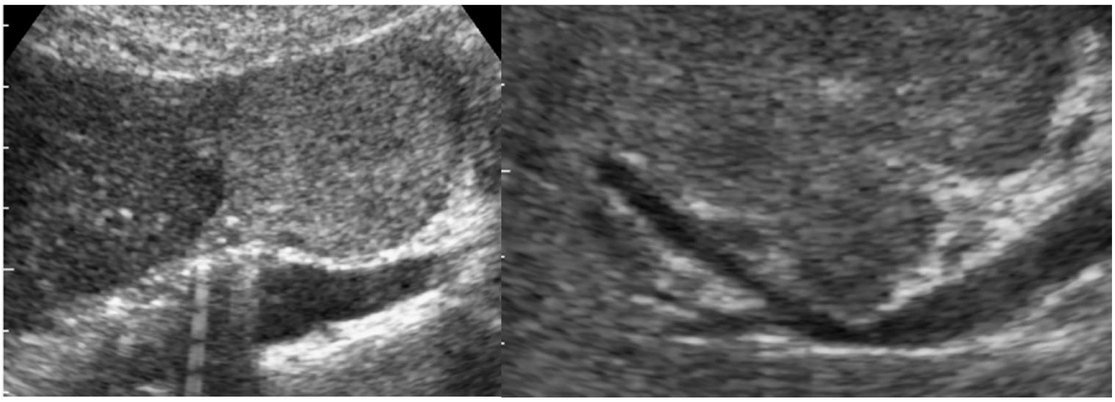


Fig. 4.3.33 a, b Hepatic misconfiguration by haemangioma (a) or malignant space occupation (b, although not (yet) vessel invasive HCC) (two different cases); UAS longitudinal

Fig. 4.3.34 Hepatic misconfiguration by gallbladder carcinoma, secondary finding cholecystolithiasis; UAS right longitudinal

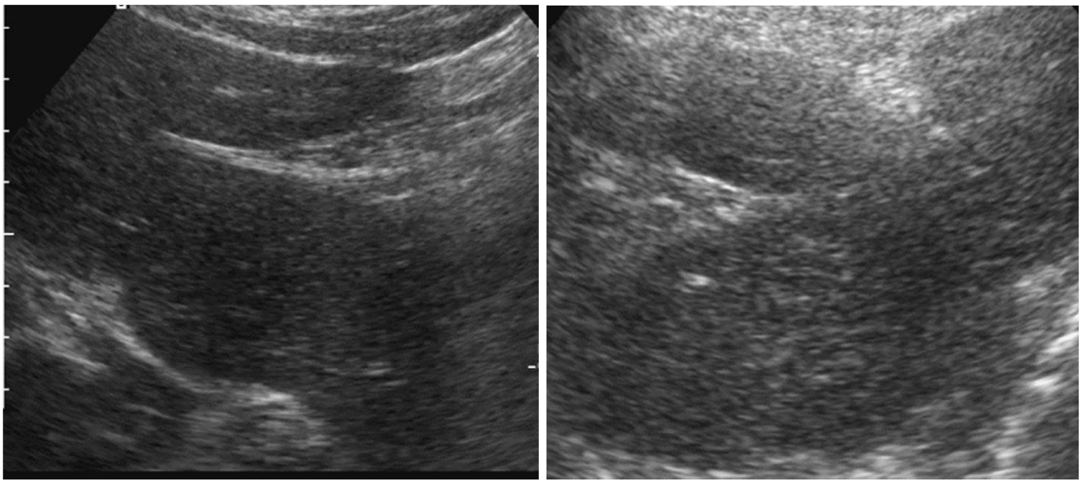


Fig. 4.3.35 a, b Hepatic misconfiguration as normal variant of left hepatic lobe (a) and after hepatic surgery (b) (two different cases); UAS transverse

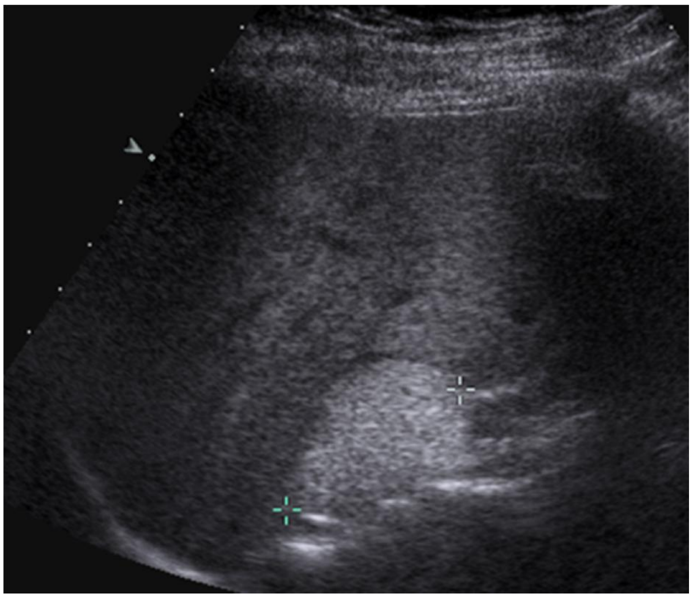


Fig. 4.3.36 Remarkably lesser displacement during inspiration as the liver and homogenously highly reflexive – highly likely adrenal gland lipoma (distance markers); FS right

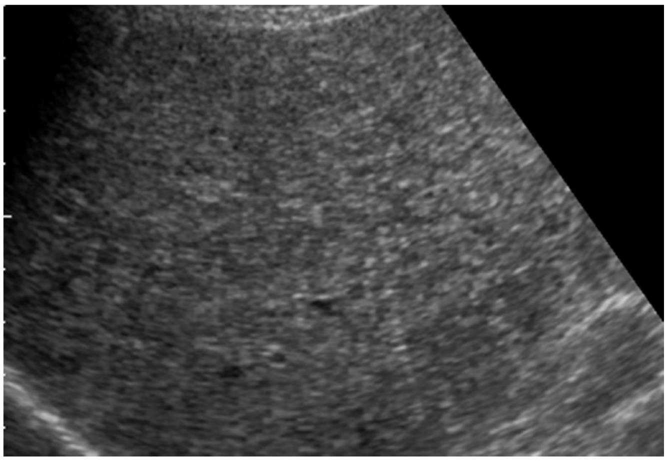


Fig. 4.3.37 Almost isoechogenic FL (clinical and in MR most likely corresponding to a haemangioma); FS right

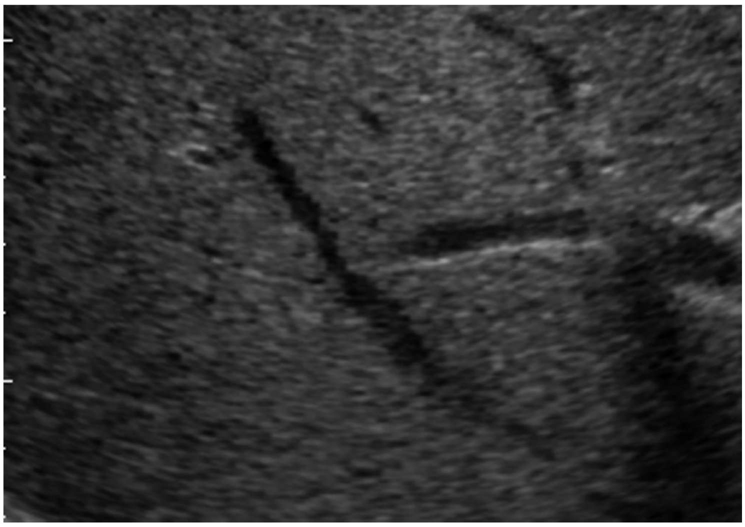


Fig. 4.3.38 Discreet but typical vessel impressions in liver cirrhosis (portal as well as hepatic vein branch); SCS right

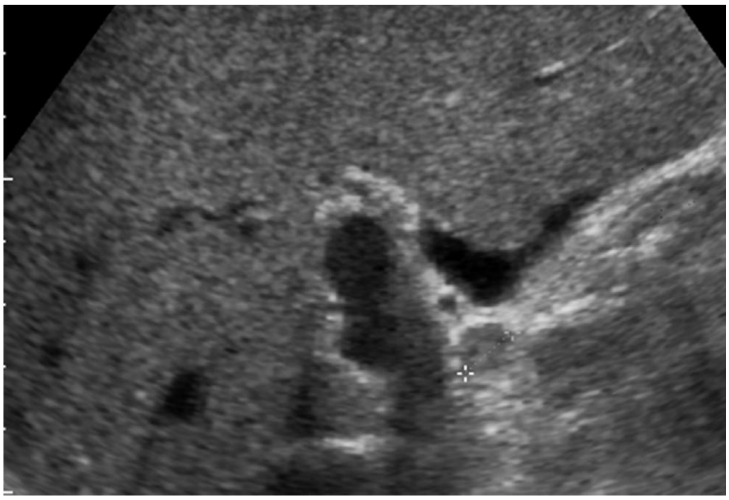


Fig. 4.3.39 Known micronodular liver cirrhosis with a little ascites and portal lymphadenopathy (measurement crosses); SCS

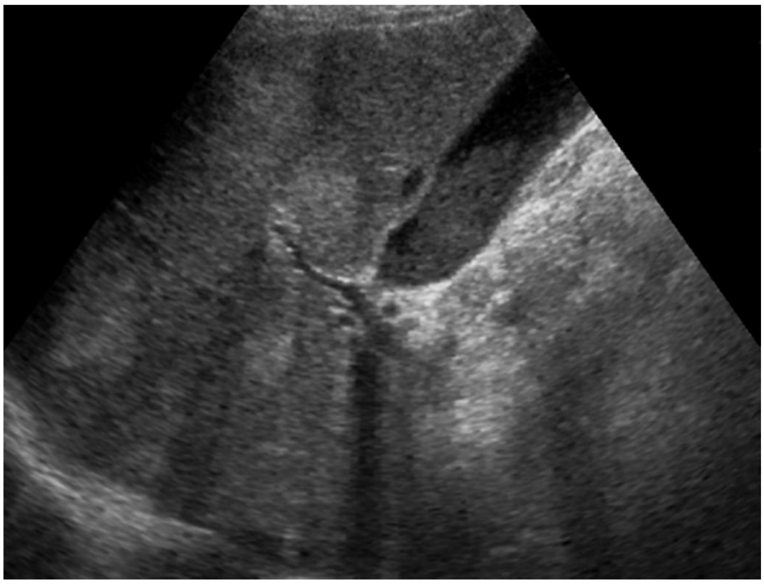


Fig. 4.3.40 Diffuse metastasis of a neuroendocrine tumour, gallbladder sludge; SCS right longitudinal

Fig. 4.3.41 FL or not? Endosonographic proof of FL; SCS right

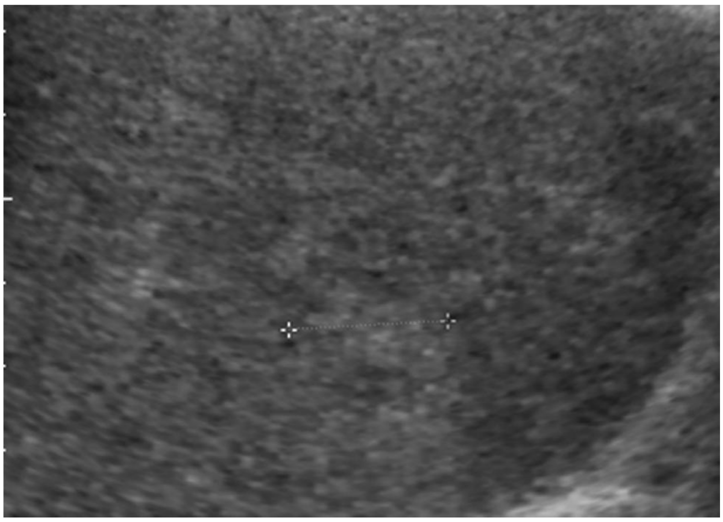


Fig. 4.3.42 Weakly representable FL with only little echo difference (classic haemangioma in MR); SCS right

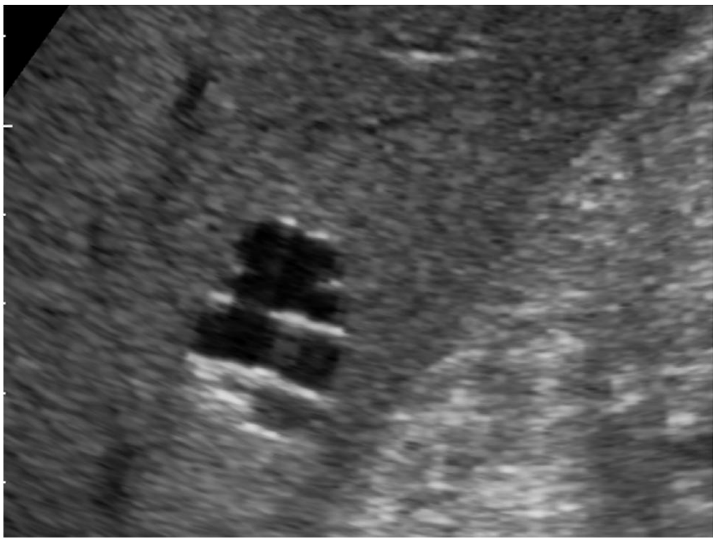


Fig. 4.3.43 Septated ("complicated" - a somewhat exaggerated designation) innocuous hepatic cyst; SCS right

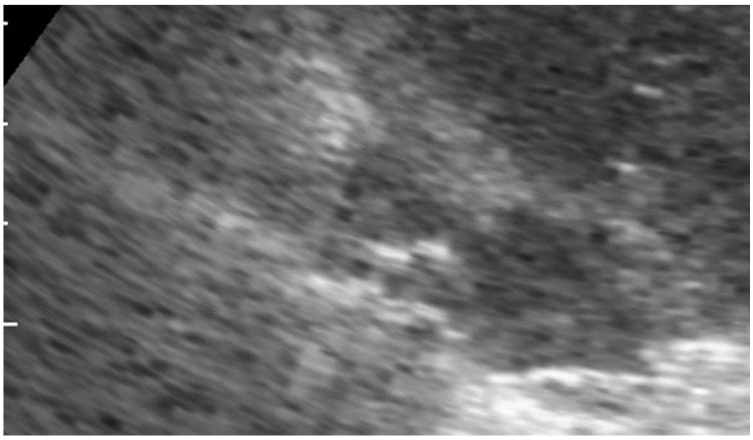


Fig. 4.3.44 Diaphragm metastasis (known bronchial cancer), no FL; SCS right

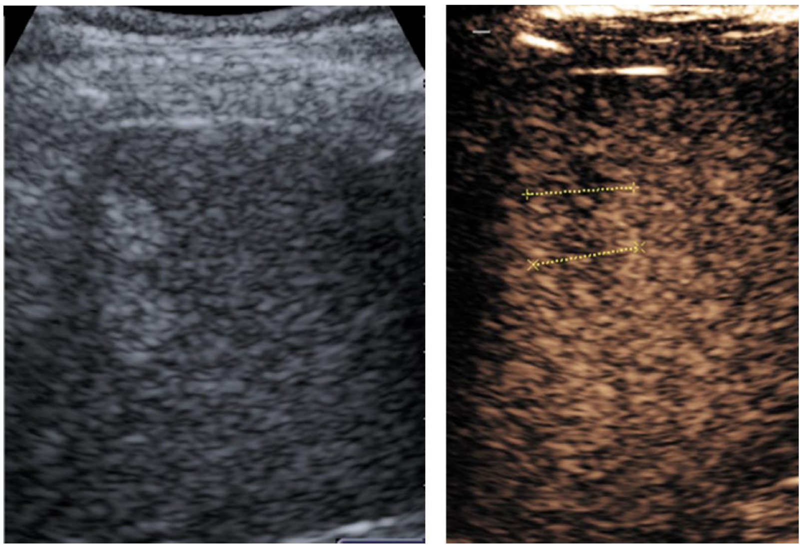


Fig. 4.3.45 a, b Liver haemangiomas; SCS right (b with CM)

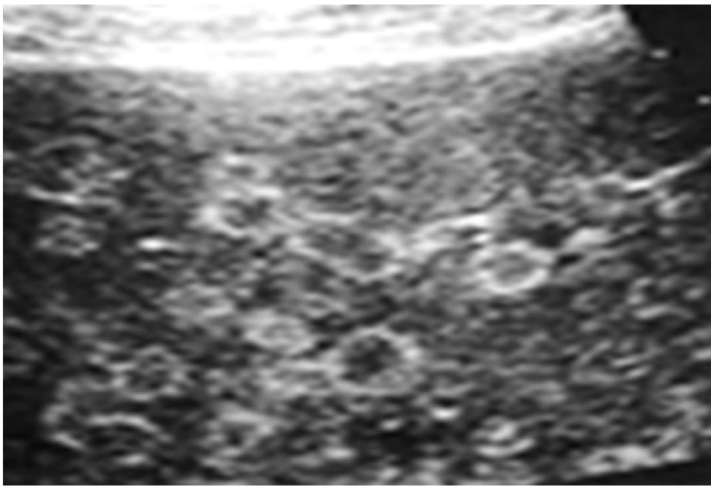


Fig. 4.3.46 Benign focal lesions (clinical porphyria); SCS right

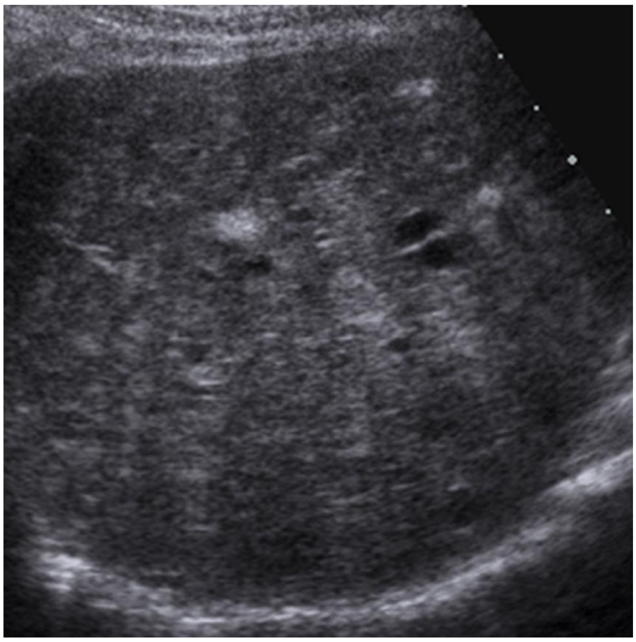


Fig. 4.3.47 Known haemangioma as well as newly occurred FL (probably corresponding to metastases of a neuroendocrine tumour); SCS right

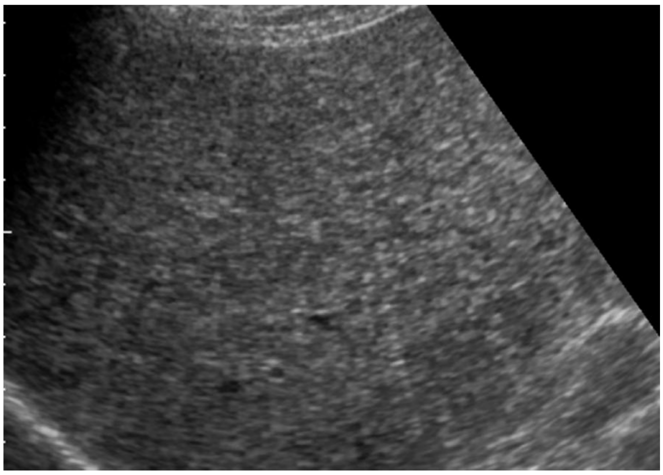


Fig. 4.3.48 Diffusely condensed parenchymal pattern ("multiplied texture") (clinically tripled "liver values"); SCS right

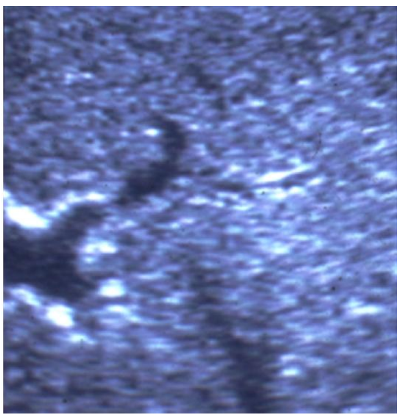
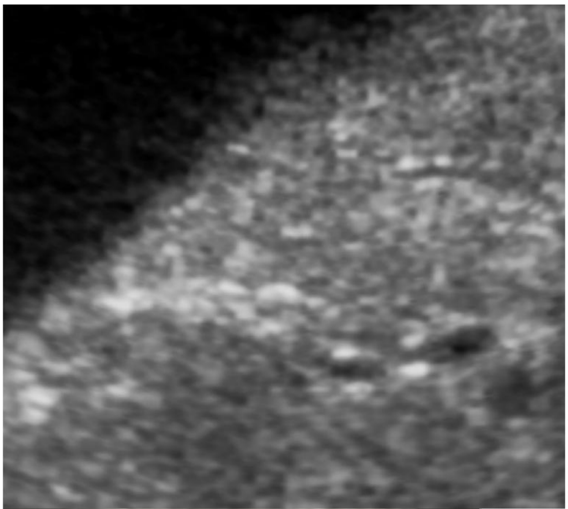
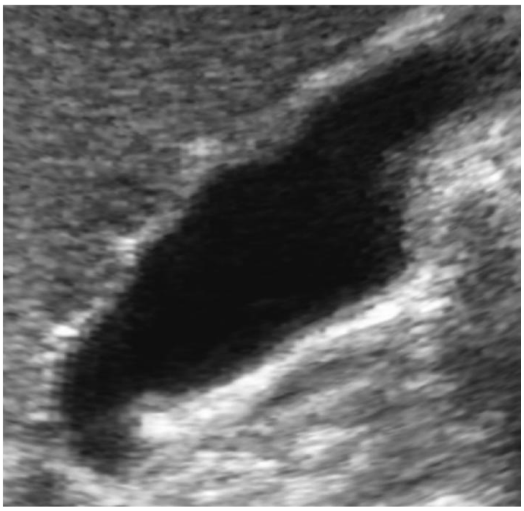
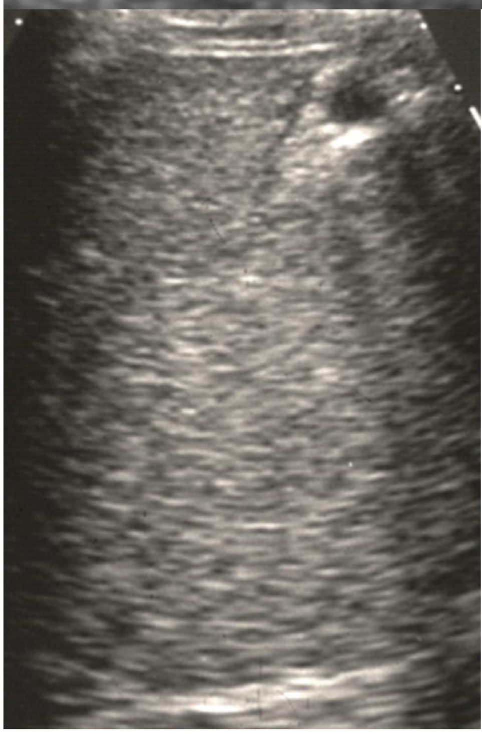
 

Fig. 4.3.49 a-c Cirrhosis-typical vessel rarefication (a, b); SCS (b), (a cast specimen, c laparoscopic view of portal hypertension)







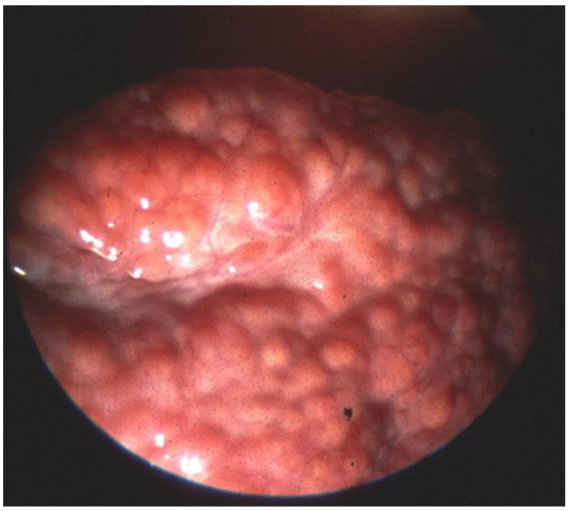


Fig. 4.3.50 a-d Cirrhosis typical vessel rarefication and hypertrophic segment I as well as – advantageous imaging by high impedance to gallbladder (b) – micronodular cirrhosis (different cases); SCS right (a) and UAS longitudinal (b, d), laparoscopic aspect in d

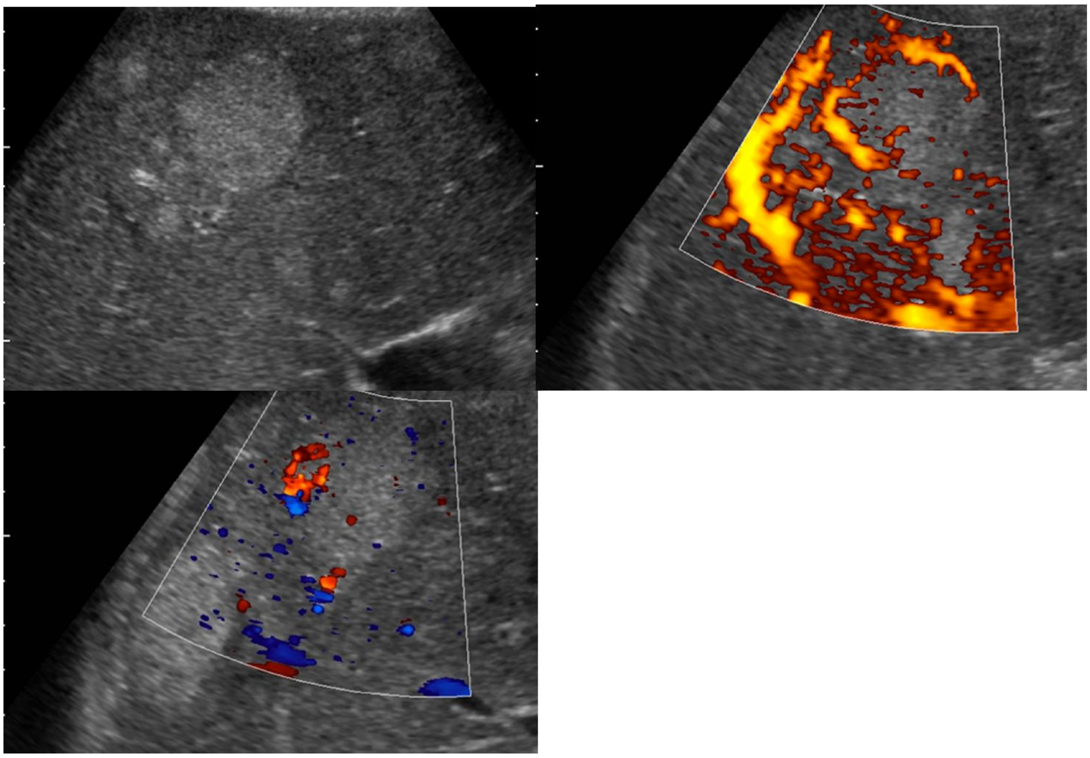


Fig. 4.3.51 a-c Known neuroendocrine carcinoma with hepatic metastases, with marked boundaries in the so-called power mode (b) and in CCDS (c); SCS right

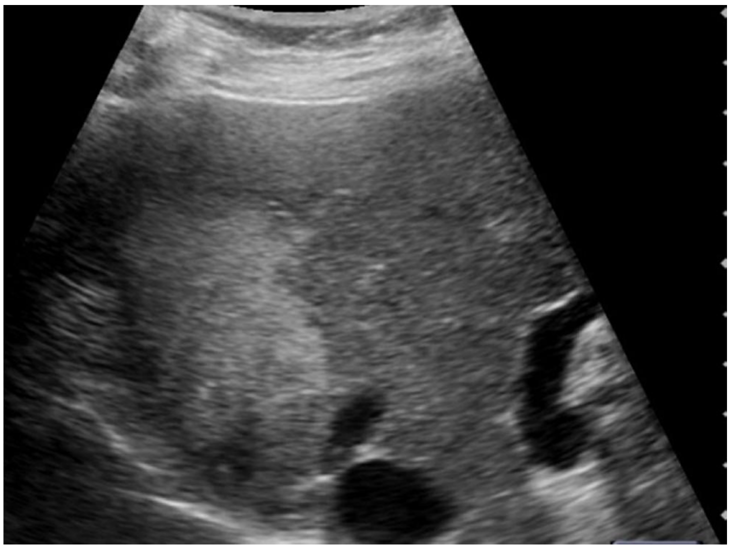


Fig. 4.3.52 Focal hyposteatosis (right and upper left image half); FS right

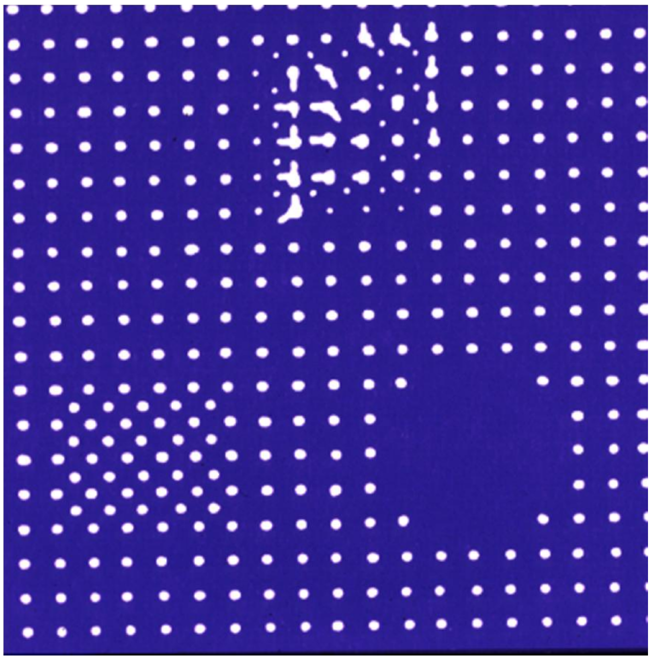


Fig. 4.3.53 Schematic representation relative to environment – e.g. to the surrounding liver parenchyma – differently echogenic FL

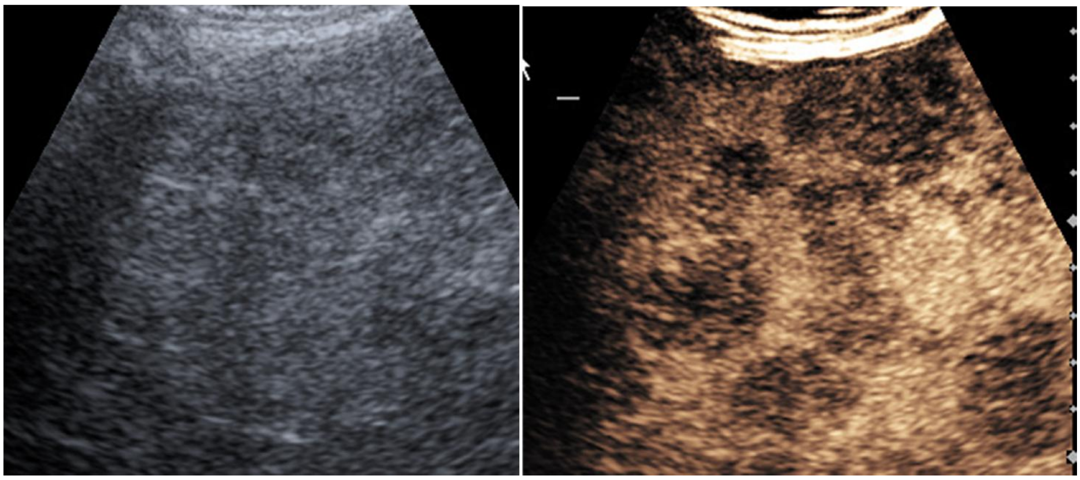


Fig. 4.3.54 a, b Metastases infiltrating the liver, obvious in CM image (b); SCS right

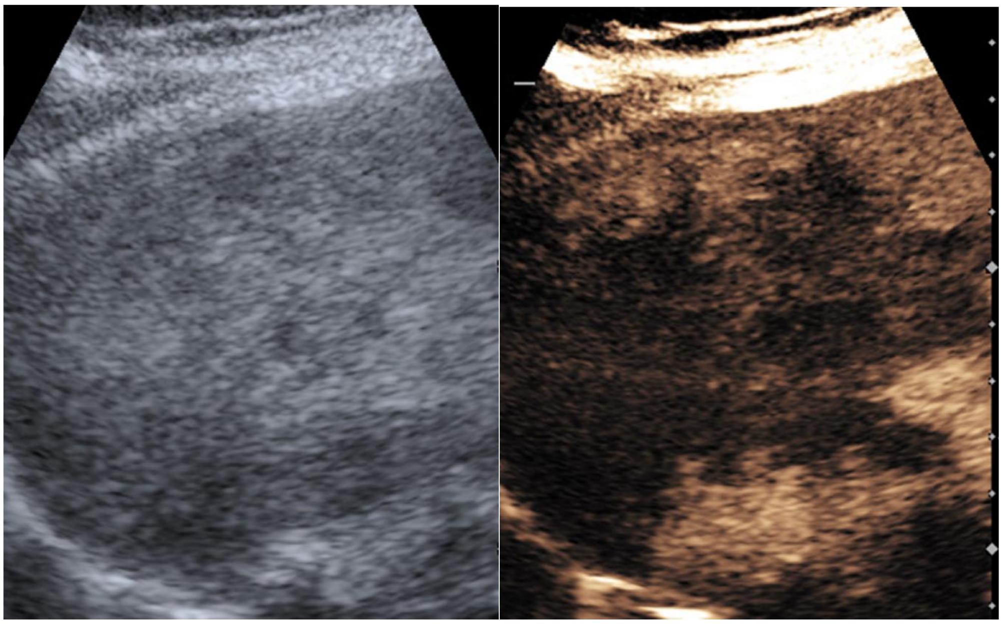


Fig. 4.3.55 a, b HCC, in non-contrast image insufficiently definable, well visible with CM (b); FS right

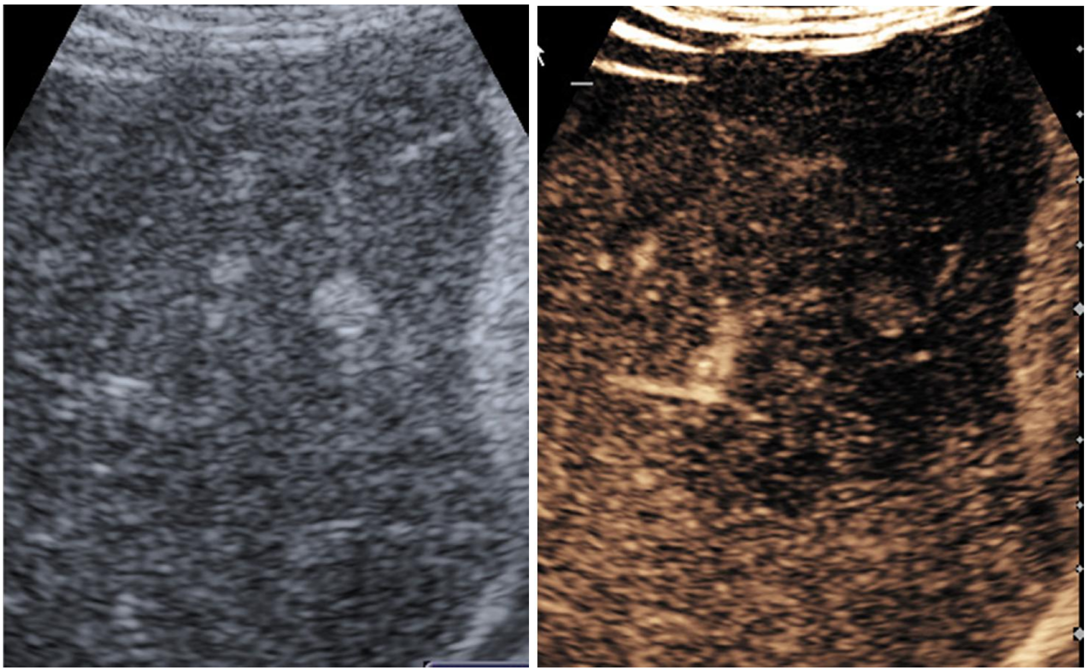


Fig. 4.3.56 a, b Without contrast medium (which was used in b) poorly recognizable hypovascular HCC; FS right

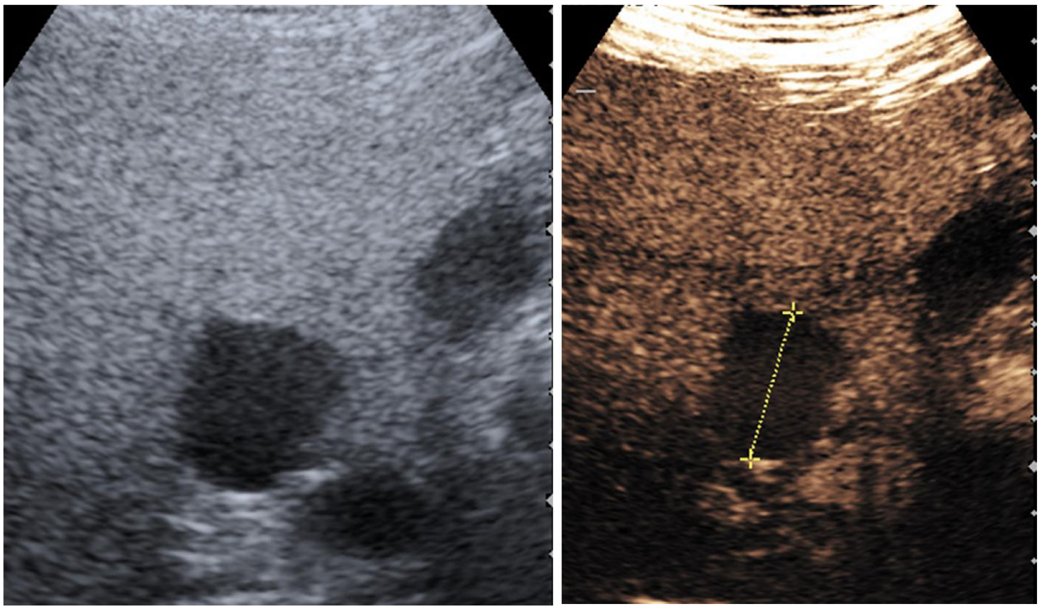


Fig. 4.3.57 a, b Hepatic cyst in a "fatty liver"; FS right (b with CM); UAS transverse

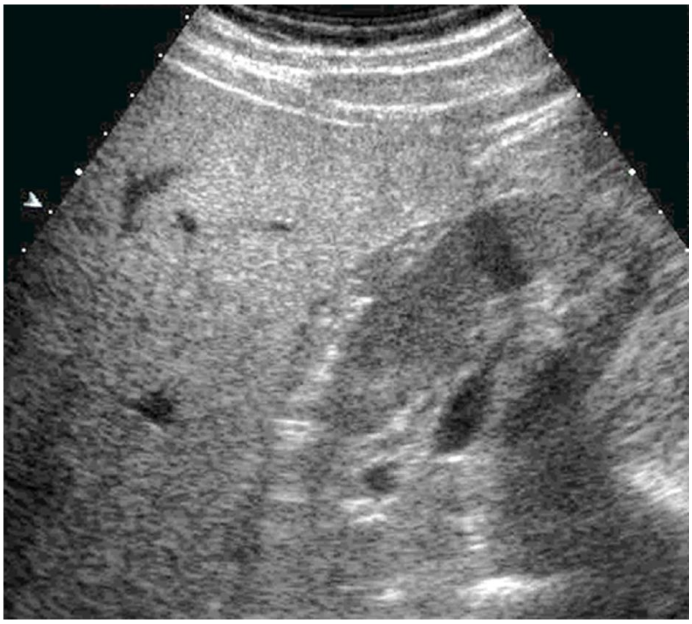


Fig. 4.3.58 "Fatty liver", marked difference in brightness of liver parenchyma and relative to right kidney, normal subcutaneous and accentuated peri-renal adipose layers ("kidney fat", which allows extra high frying temperatures); FS right

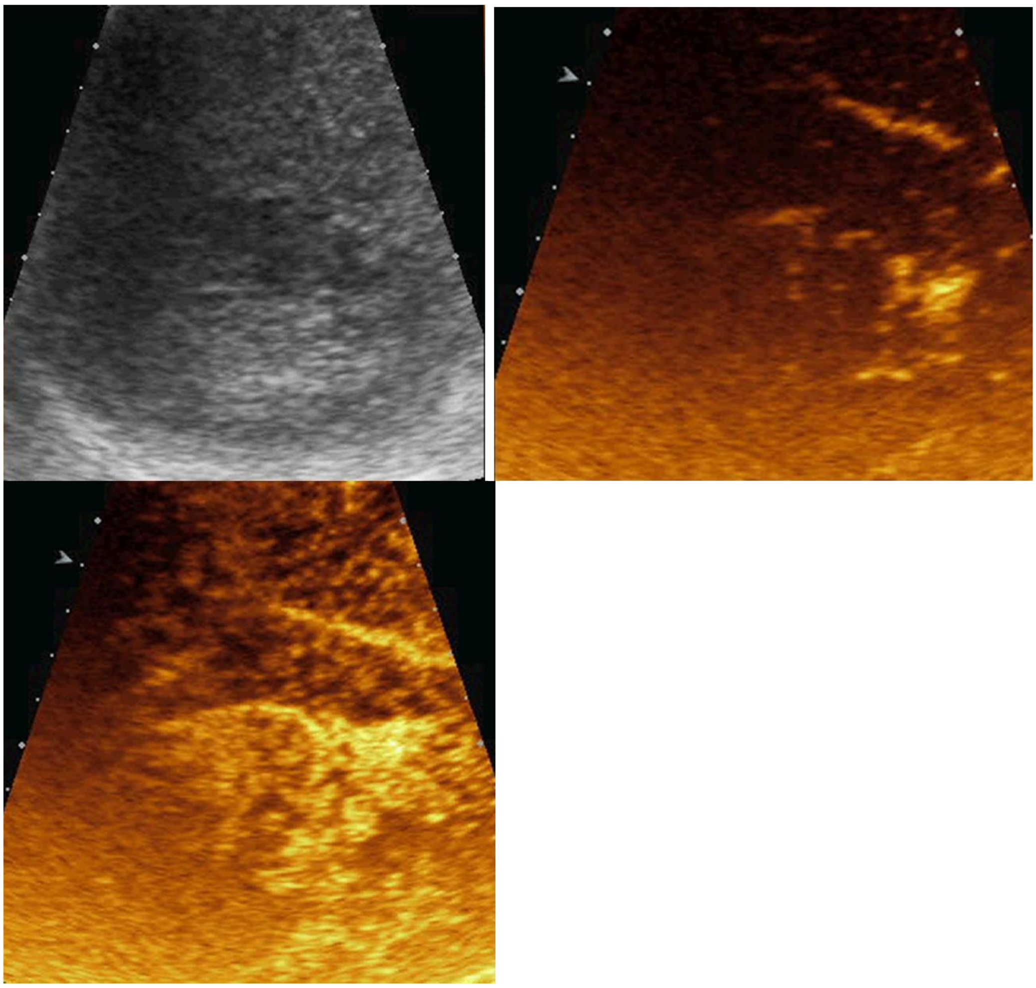


Fig. 4.3.59 a-c Very early and early CM filling phase (b and c with second-long delay) of a poorly definable FL (clinical criteria of tumour thrombosis corresponding to HCC); SCS right

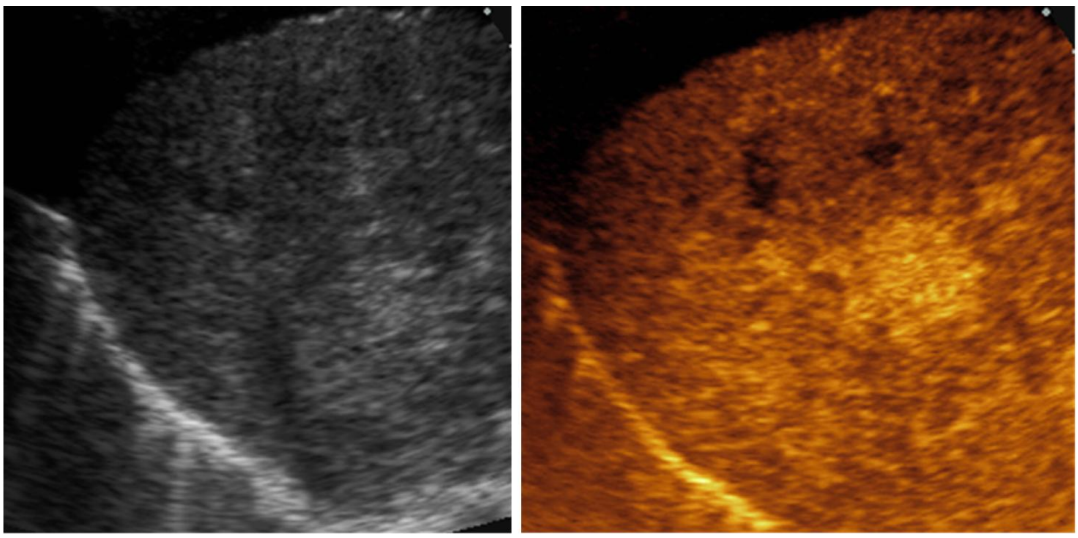


Fig. 4.3.60 a, b Poorly definable hyperperfused FL of the liver (clinical probable HCC); SCS right, with CM (b)

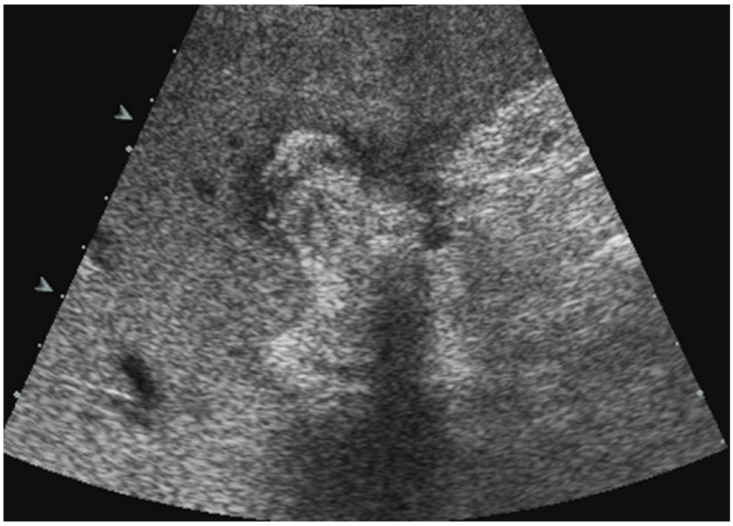


Fig. 4.3.61 Bizarre appearing FL – two weeks after laparoscopic cholecystectomy; FS right

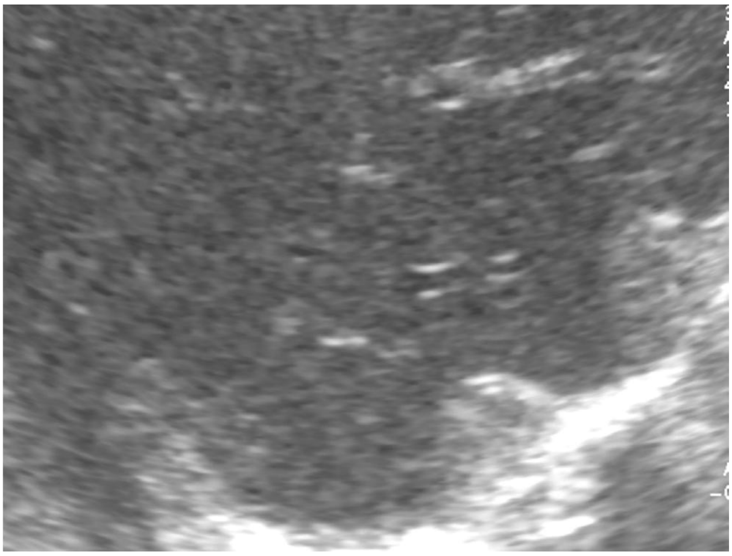


Fig. 4.3.62 Appears to be a FL – in reality diaphragm crus; FS right

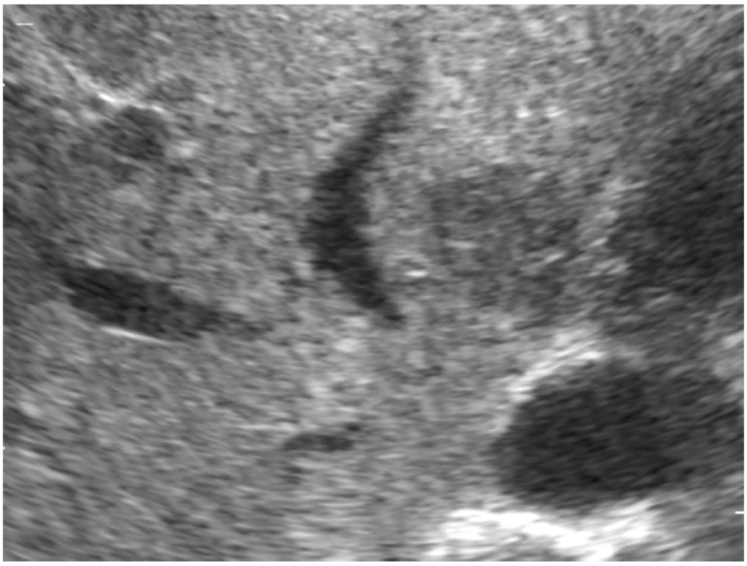


Fig. 4.3.63 Easily overlooked (clinically ultimately malign) FL; SCS right

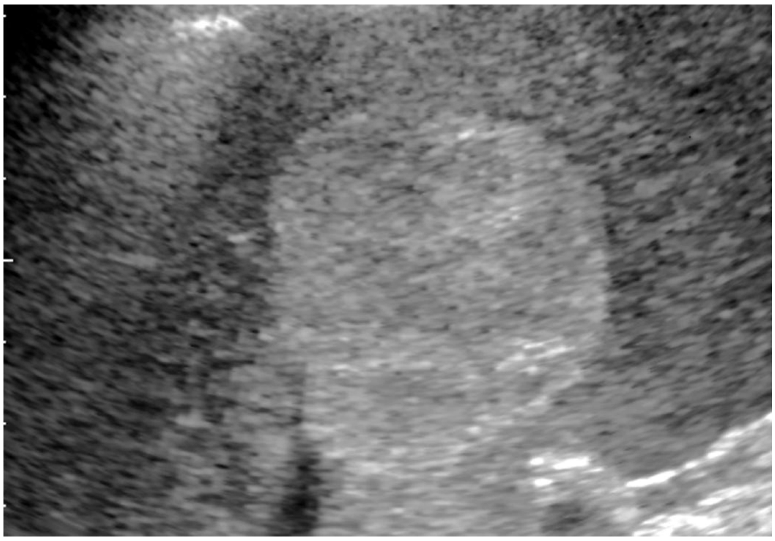


Fig. 4.3.64 Seems to be large haemangioma (with clinical wellness and normal "liver values" wait-and-see monitoring procedure with sonographic check-ups possible, no CT or MR examination); SCS

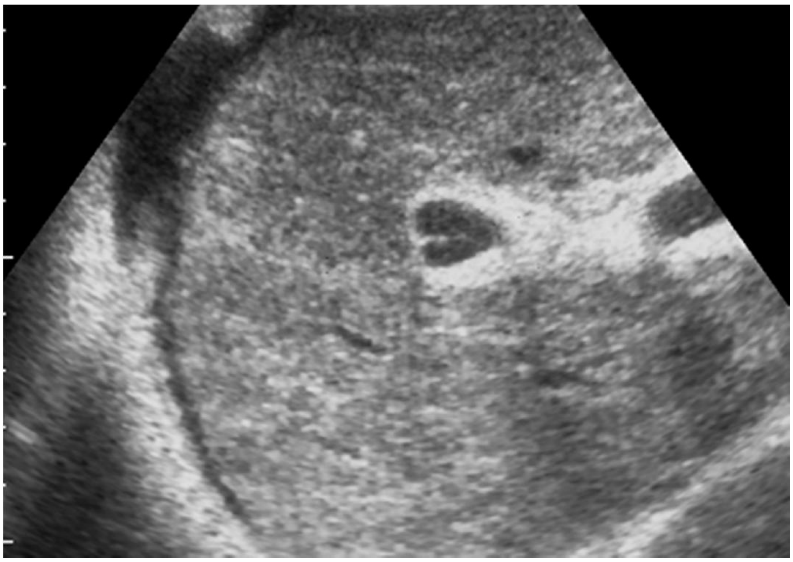


Fig. 4.3.65   Decompensated liver cirrhosis, regeneration nodes HCC? FS right

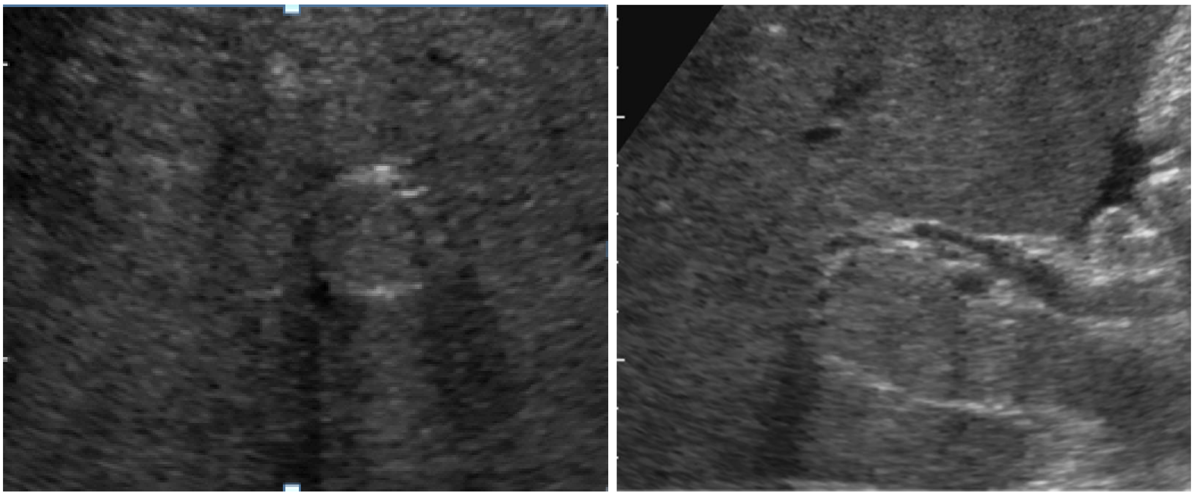


Fig. 4.3.66 a, b   Tumour thrombosis in HCC, not the initially assumed FL; SCS (a) and FS right (b)

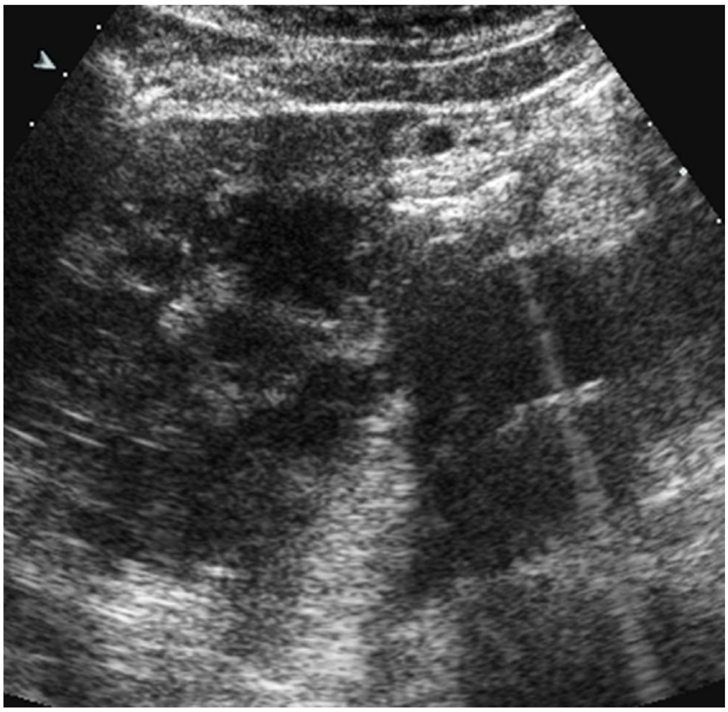


Fig. 4.3.67 Abscess forming necrotizing pancreatitis with hepatic abscess invasion; UAS longitudinal

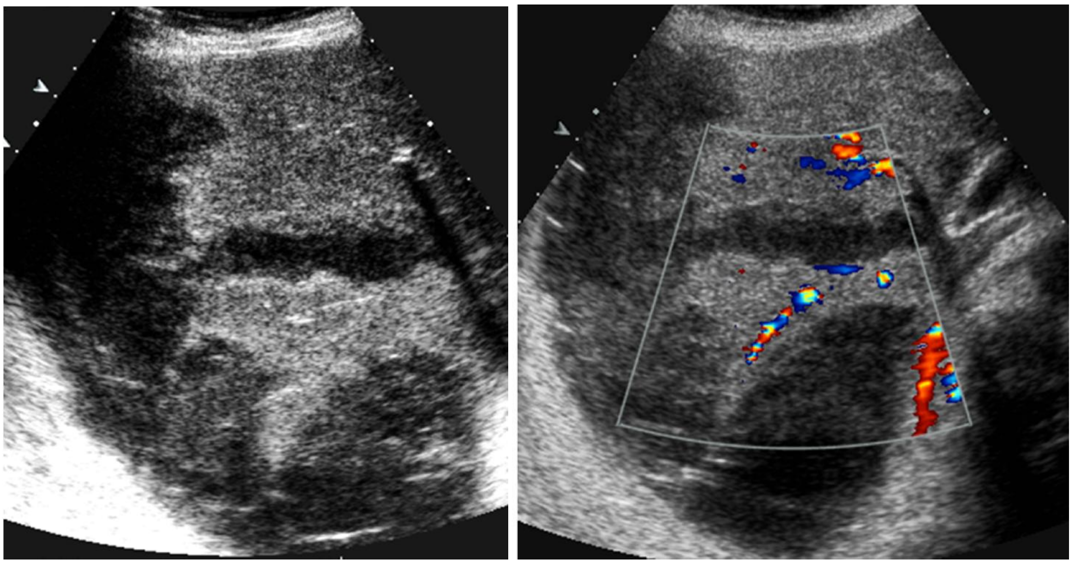


Fig. 4.3.68 a, b Post-traumatic liver rupture (a) (deep breathing with installation of percutaneous bile duct drainage (PTCD)) with haemorrhagic ascites and check-up after two weeks with CCDS (b); SCS

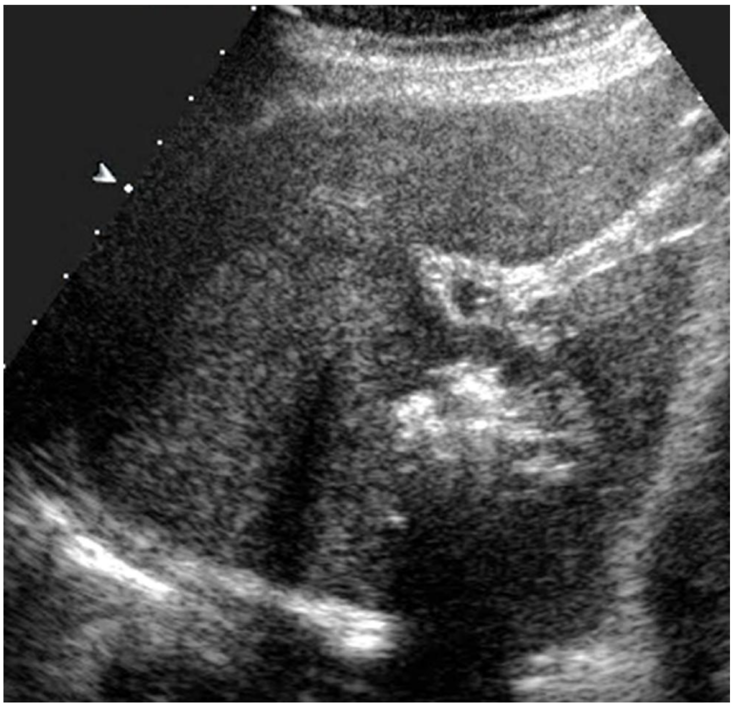


Fig. 4.3.69 Unclear remaining FL with mixed echo (old calcified liver abscess?, no further work-up in good general physical condition and advanced age, as well as lacking therapeutic consequences); UAS longitudinal

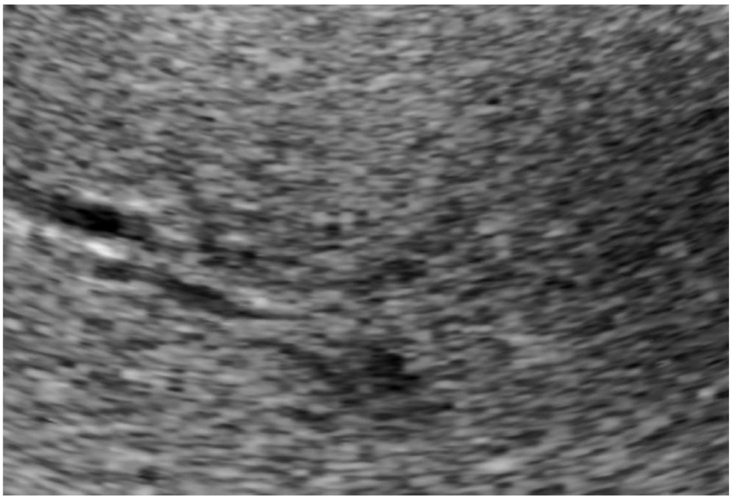


Fig. 4.3.70 Easily overlooked almost isoechogenic FL with local biliary obstruction (discreet but unequivocal so-called double-barrelled shotgun phenomenon – a rather martial expression) (clinical metastasis); SCS right

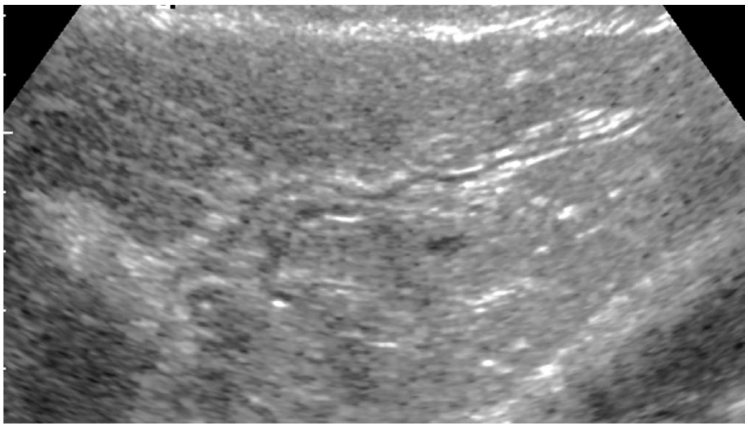


Fig. 4.3.71 Also discreet but clear so-called double-barrelled shotgun phenomenon as evidence of a local obstruction (clinical CCC) (note the "sono-friendly" pathway of the vessels in segment II and also in segment III); UAS transverse

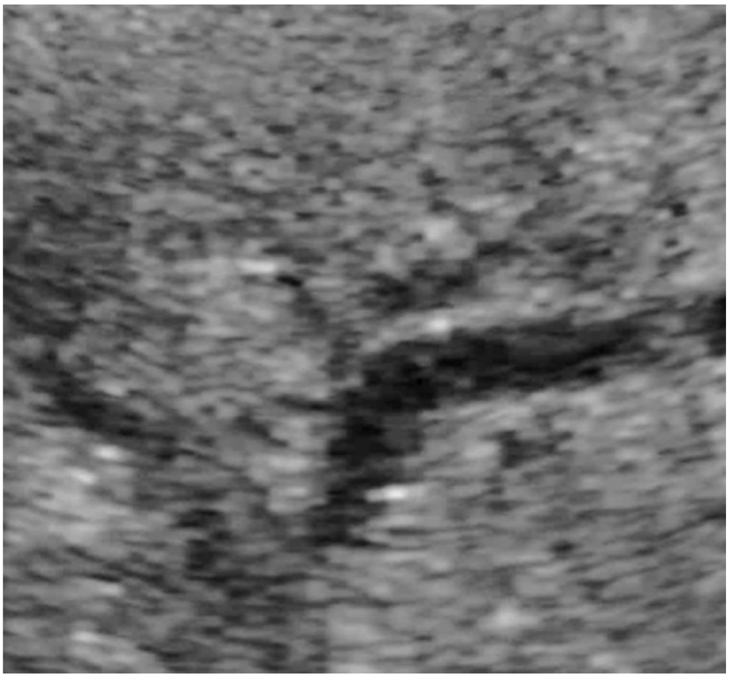


Fig. 4.3.72 Biliary local congestion from hardly discernible FL (CCC) in segment II of the liver; UAS transverse (b with CCDS)

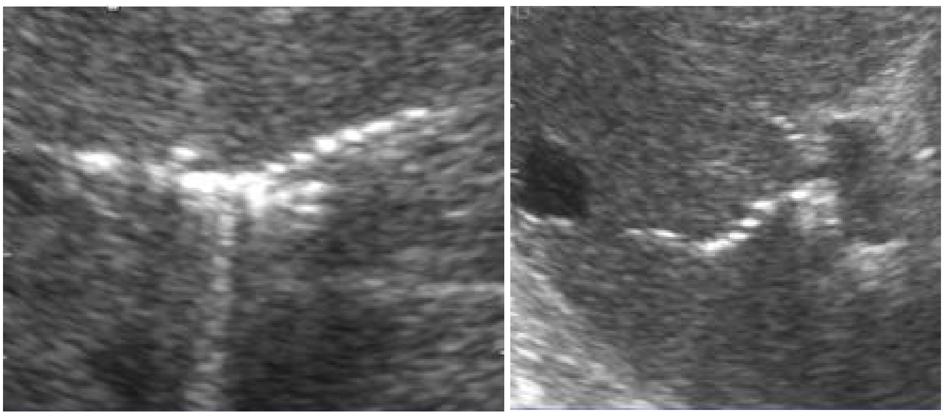


Fig. 4.3.73 a, b Aerobilia after extensive endoscopic papillotomy; SCS right (a)

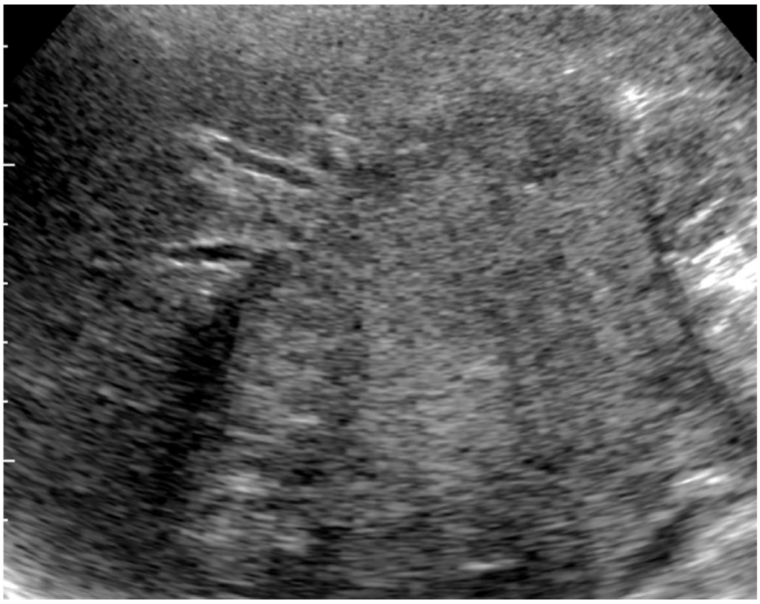


Fig. 4.3.74 Large CCC in portal position ("Klatskin´s tumour") with biliary congestion; FS right

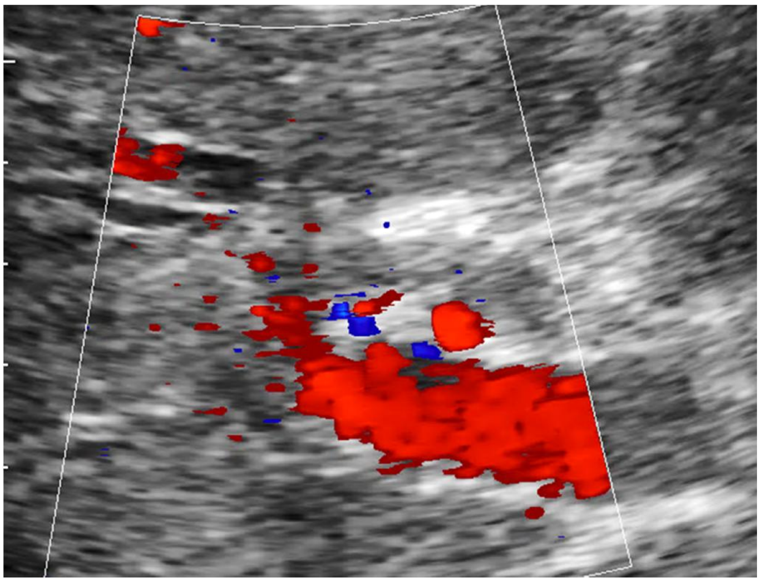


Fig. 4.3.75 Additional Klatskin`s tumour with infiltration of the hepatic bile duct (DHC) and typical interjacent crossing of the right hepatic artery branch; FS right

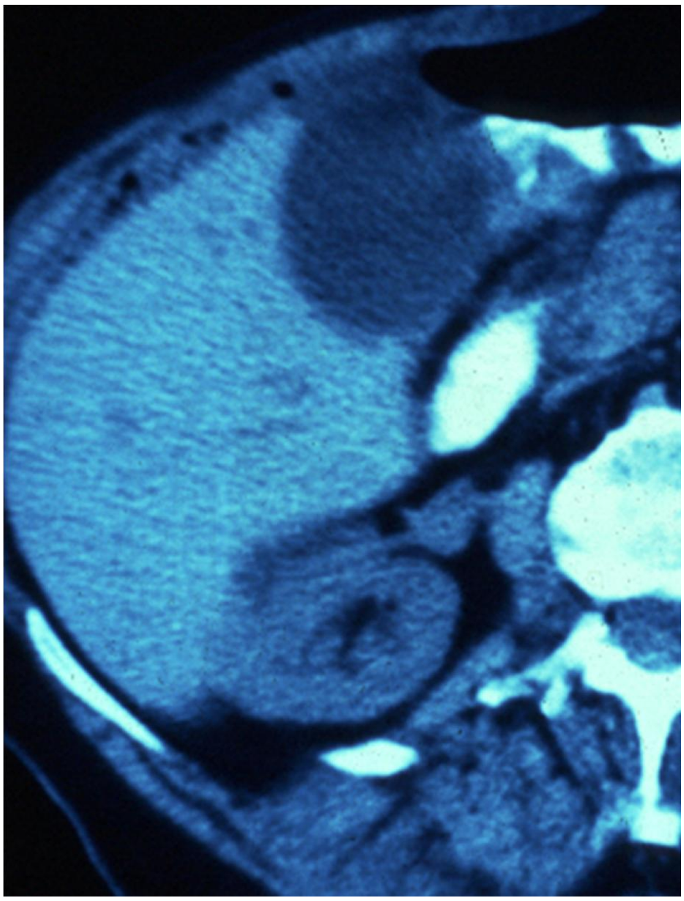


Fig. 4.3.76 Superfluously "confirmed" hepatic cysts by CT

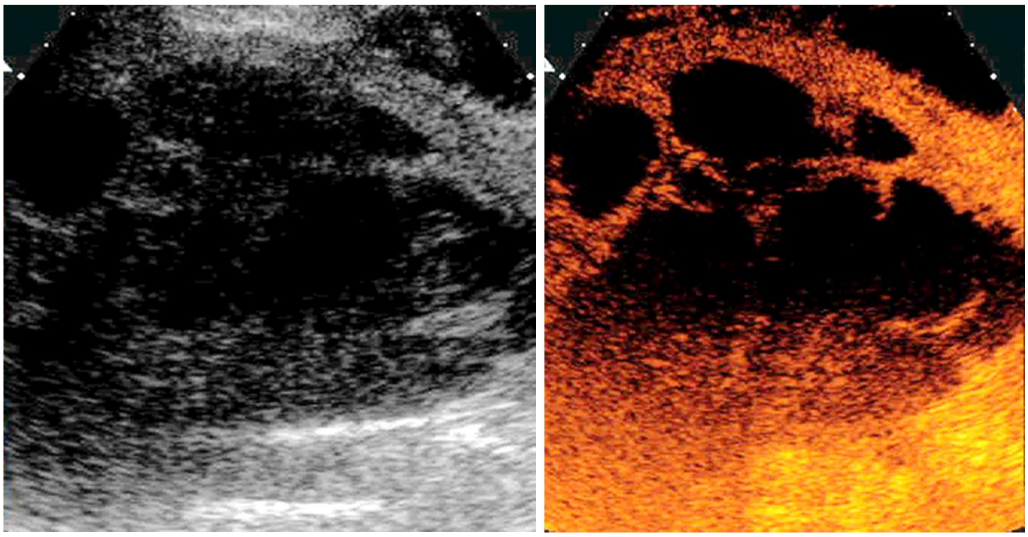


Fig 4.3.77 a, b Only by the lack of CM perfusion sonography proven (symptomatic) chambered abscess formation; FS right

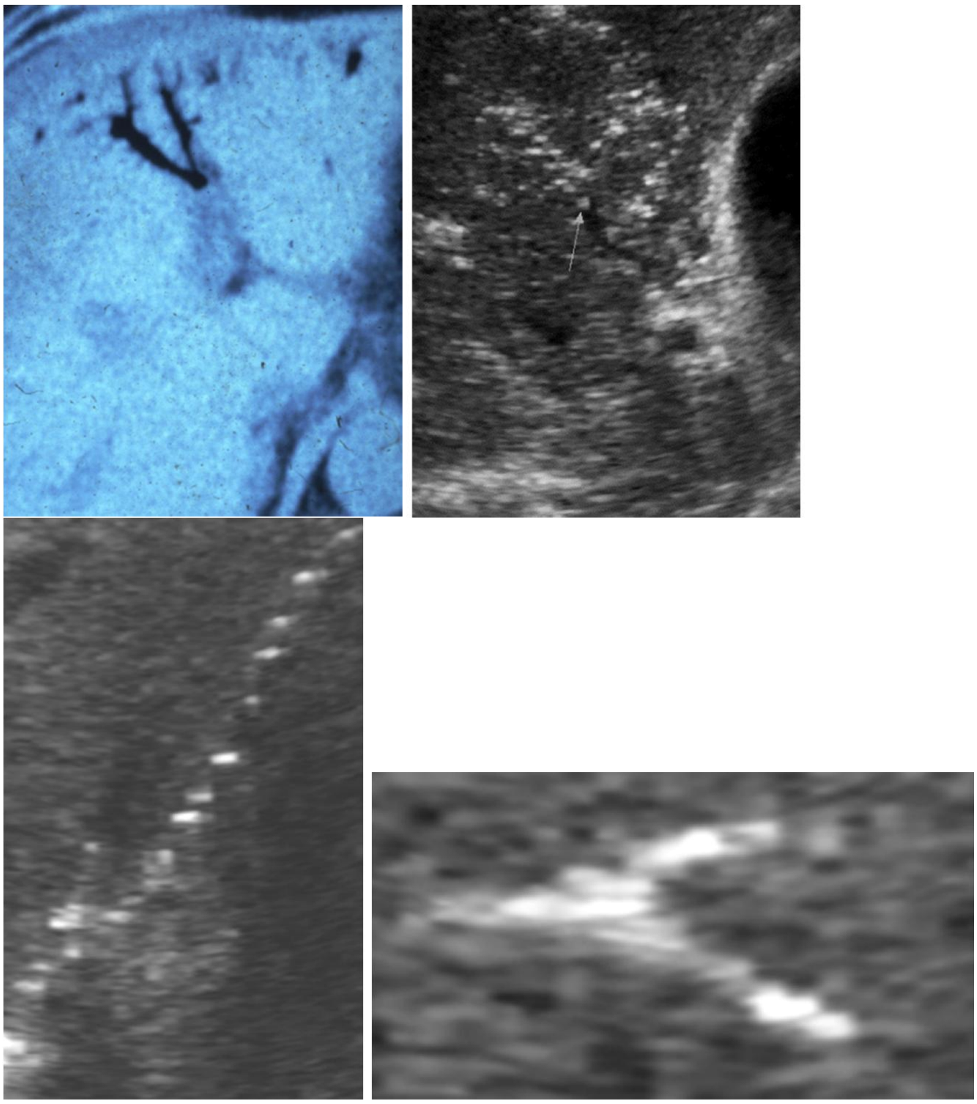


Fig. 4.3.78 a-d No aerobilia (false diagnosis by CT), but gas filling ("air") in the portal system (left and middle third of the picture); aerobilia is as a rule less diffuse and characterized by a more vivacious pulsatile motion (c and d, with section magnification in c); SCS right

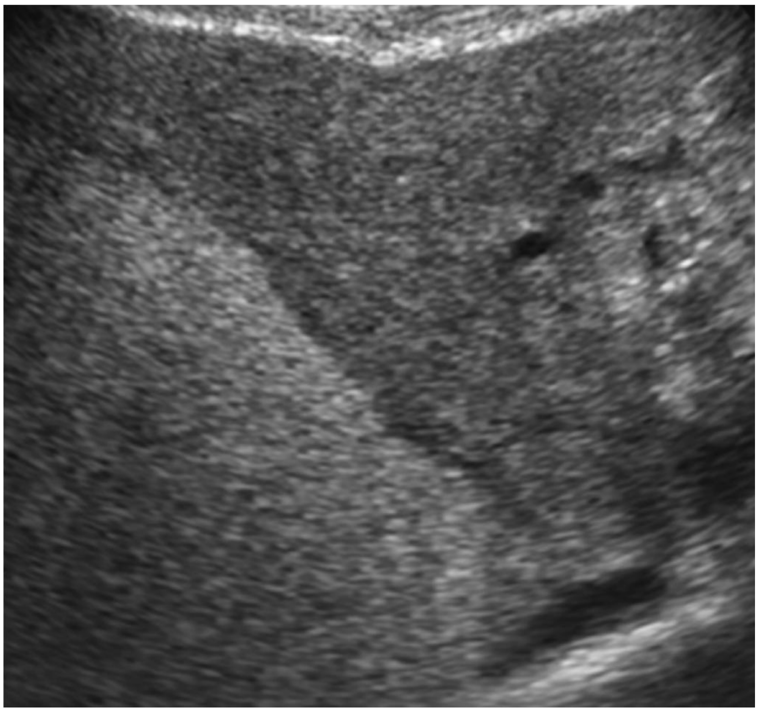


Fig. 4.3.79 Equal echo difference of right (hypoechoic) and left liver lobe with unilateral biliary congestion (clinical CCC of left bile duct bifurcation); SCS right

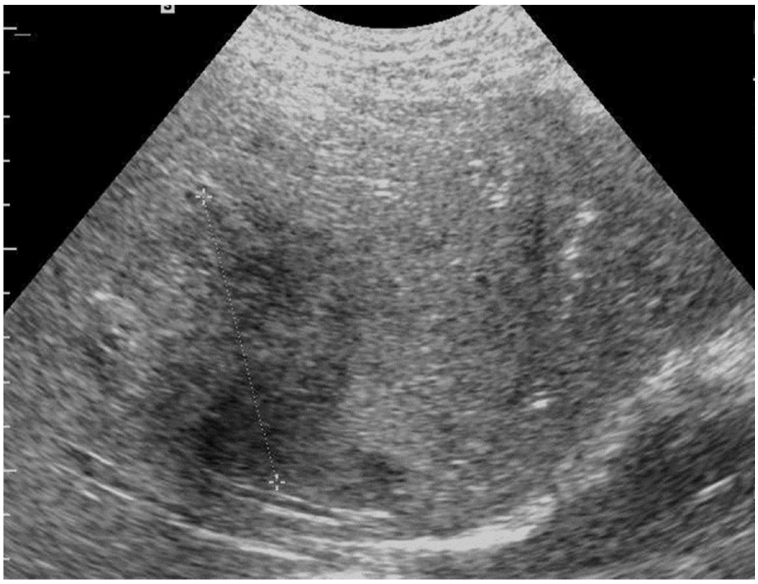


Fig. 4.3.80 Easily overlooked (clinical ultimately malign) FL, only visible and verifiable by thorough examination (positioning on left side!) (measurement crosses); FS right

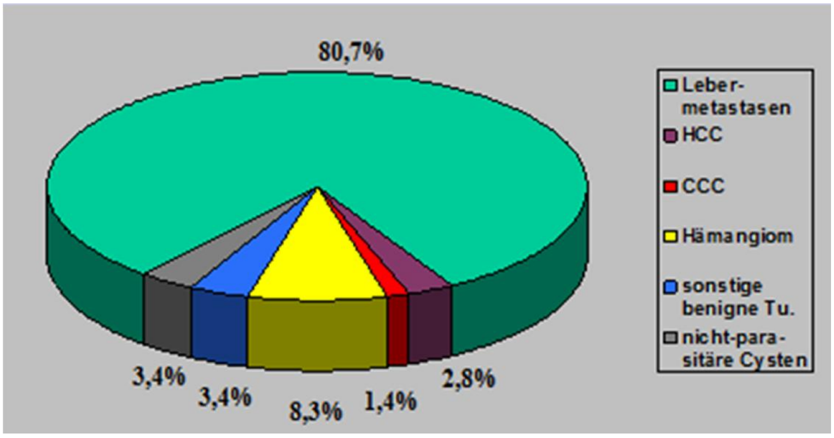


Fig. 4.3.81 Frequency distribution (autoptic) of hepatic FL (colour) and as normal appearing liver parenchyma (green) ("Görlitzer study")

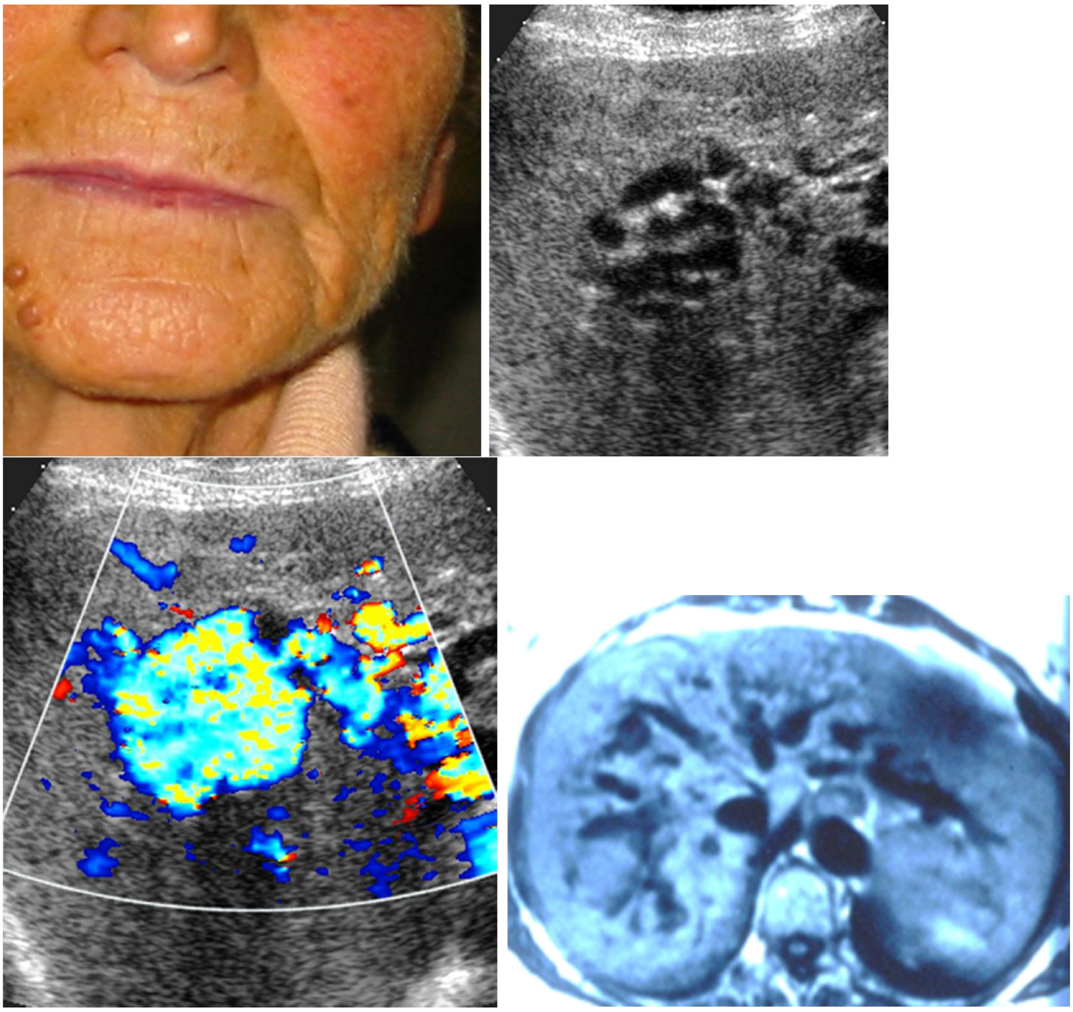


Fig. 4.3.82 a-d Hepatic involvement in Osler-Weber-Rendu disease, no hepatic cysts; (c, d with CCDS, arterial flow in e), SCS right (a, b)

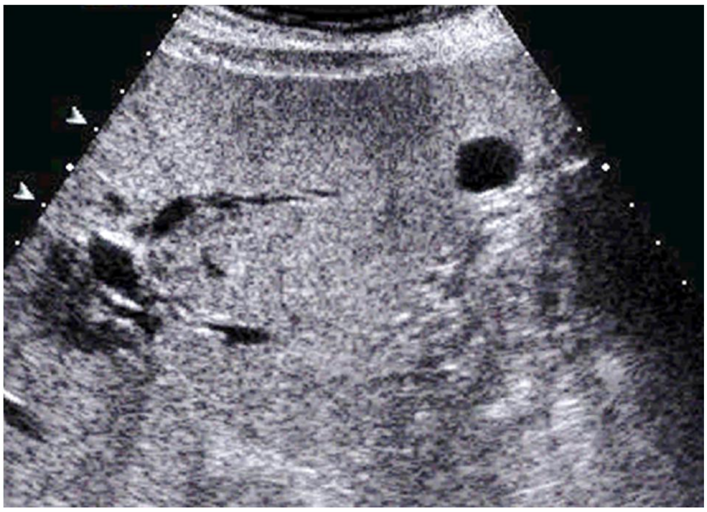


Fig. 4.3.83 Clear boundaries of hepatic cyst next to malignoma typical poorly definable vessel invading second FL, condensed parenchymal pattern (condensed texture) of the liver ("fatty liver"); SCS right

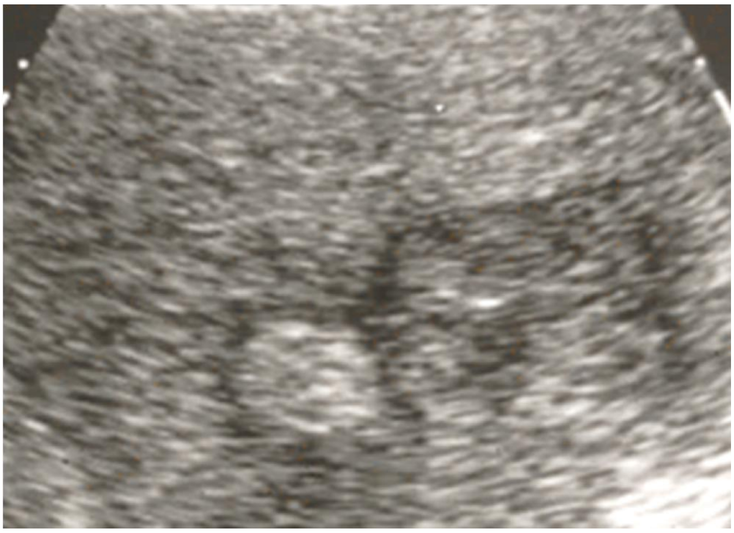


Fig. 4.3.84 Clearly defined FL (probably corresponding to a haemangioma) next to a malignoma typical poorly delimitable second FL (clinical metastasis); SCS right

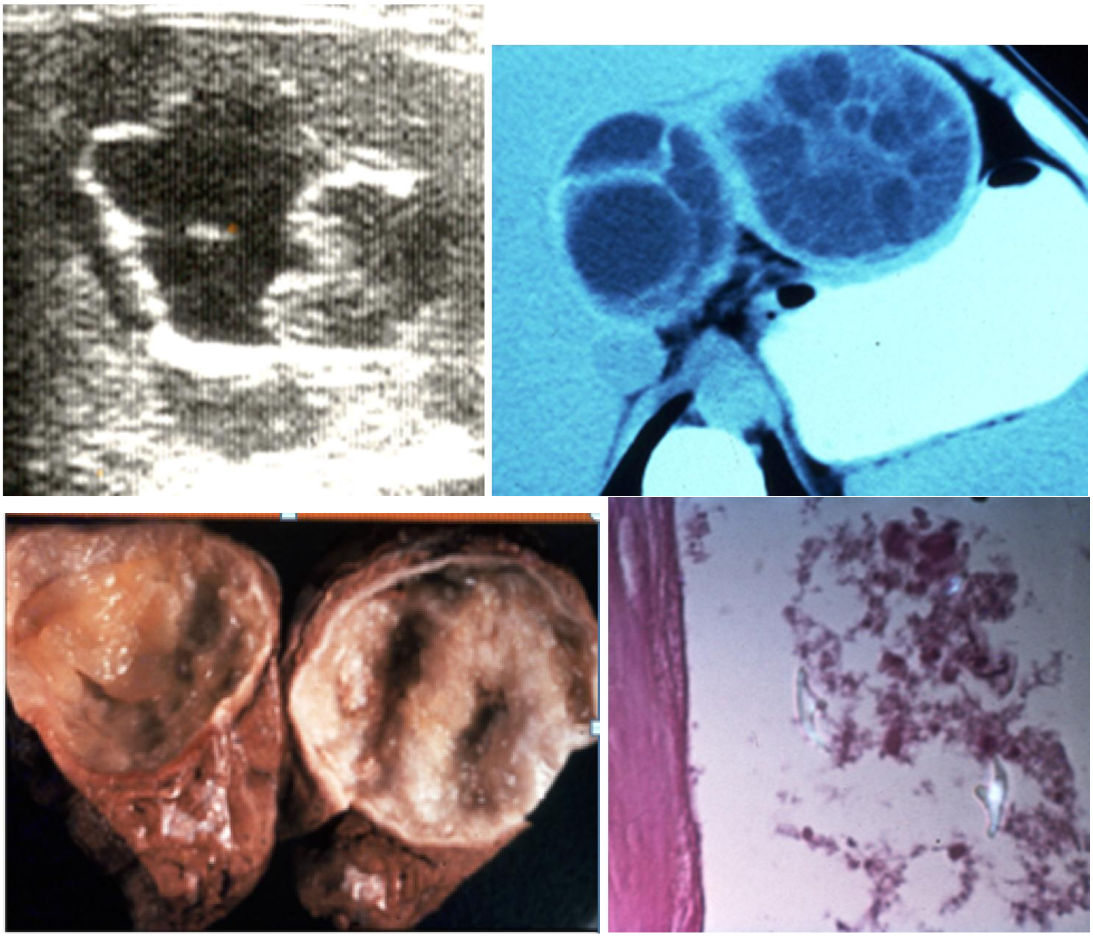


Fig. 4.3.85 a-d Hepatic FL (clinical, sonography guided puncture, and surgical treatment of echinococcosis); SCS right (a), (b radiological (CT) view, c histological and d histological preparation) (different cases)

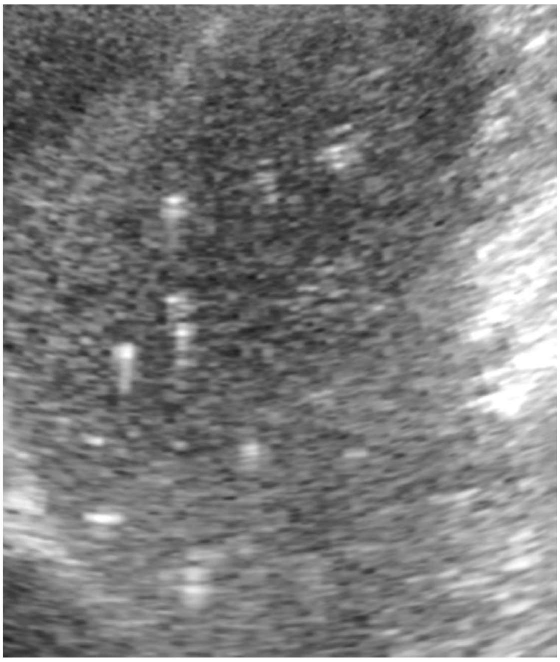


Fig. 4.3.86 Hepatic microlithiasis with bright reflexions of small FL (probably originating from normal bile ducts); FS right

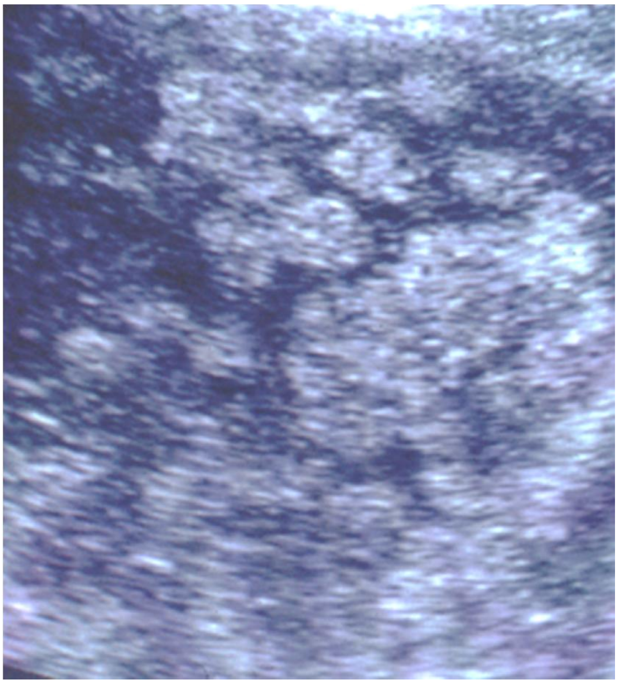


Fig. 4.3.87 Haemangiomatosis of the liver; SCS right

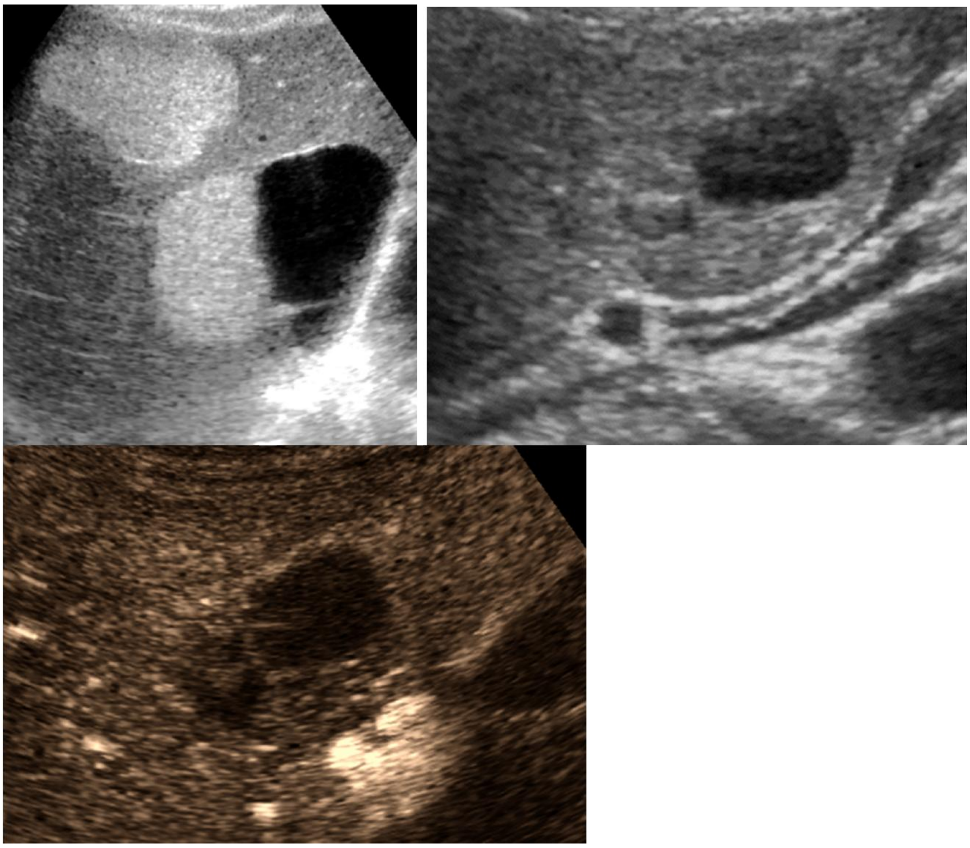


Fig. 4.3.88 a-c FL (clinical metastasis of an endocrine tumour) and right renal artery between inferior vena cava and diaphragm (a); LS (b with CM)

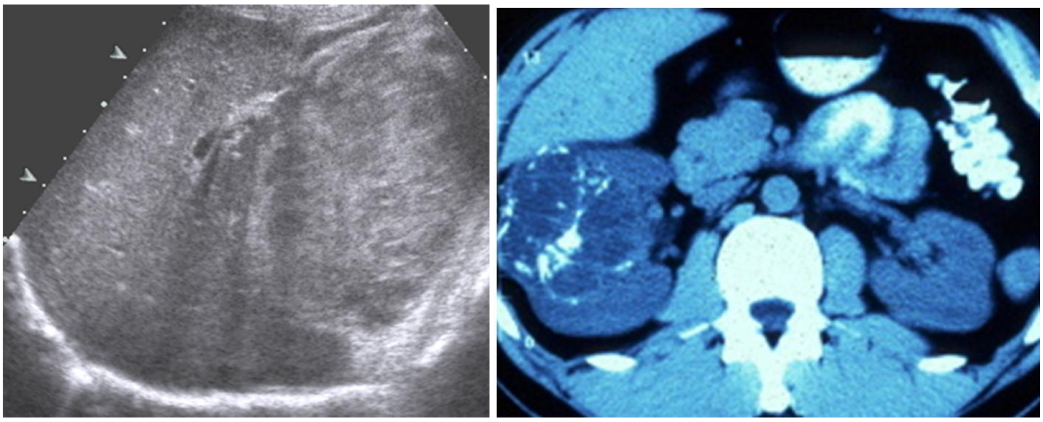


Fig. 4.3.89 a, b No FL, but respiratory-dynamically separating adrenal gland tumour; FS right (a)

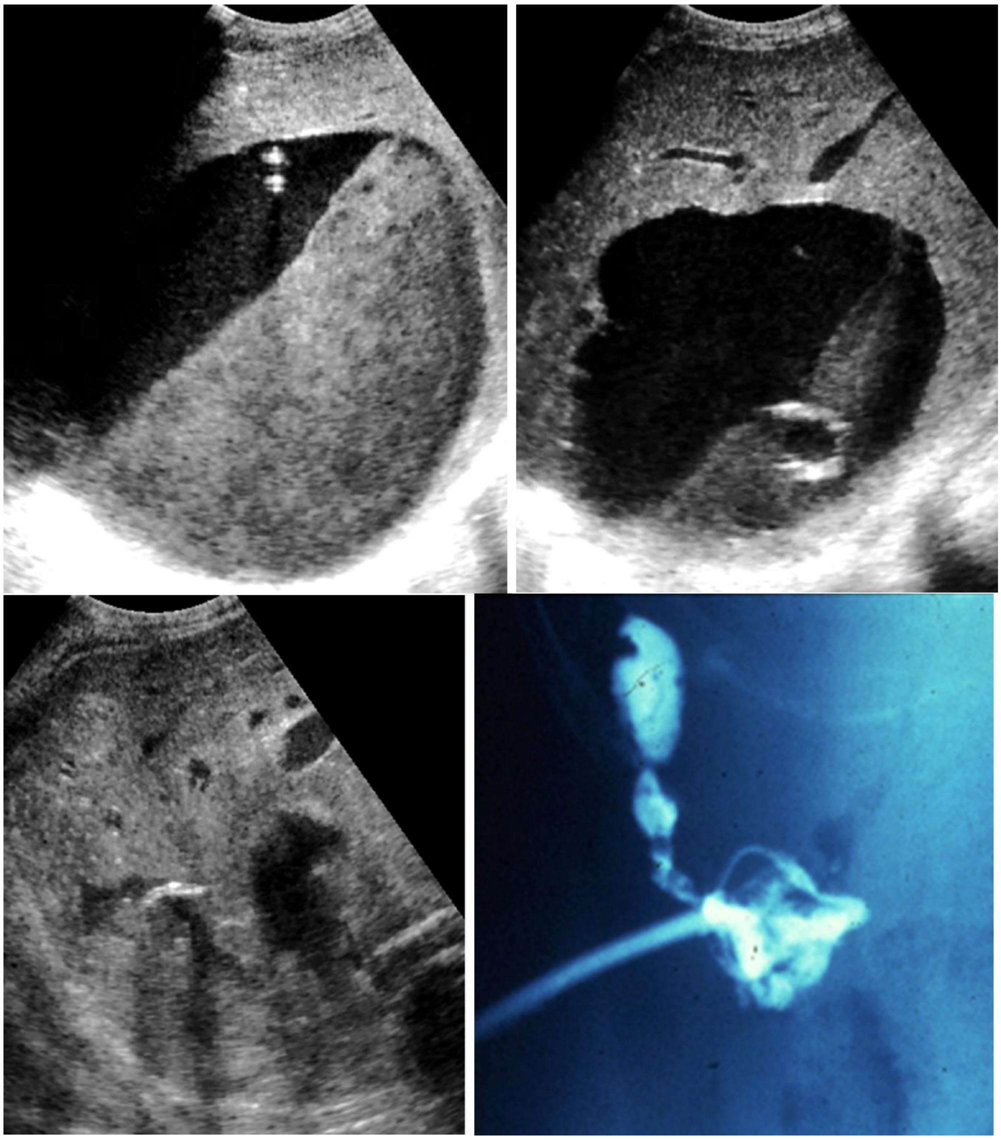


Fig. 4.3.90 a-d Puncture sonographic (and clinical) liver abscess; SCS diagonal (c and d after sonography guided puncture and drainage)

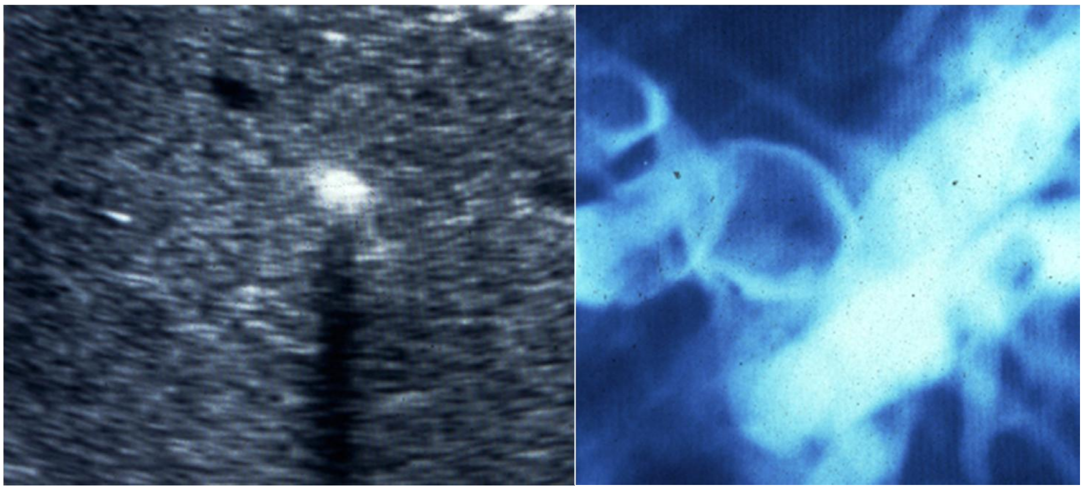


Fig. 4.3.91 a, b No FL, but hepatolithiasis; FS right (b ERCP)

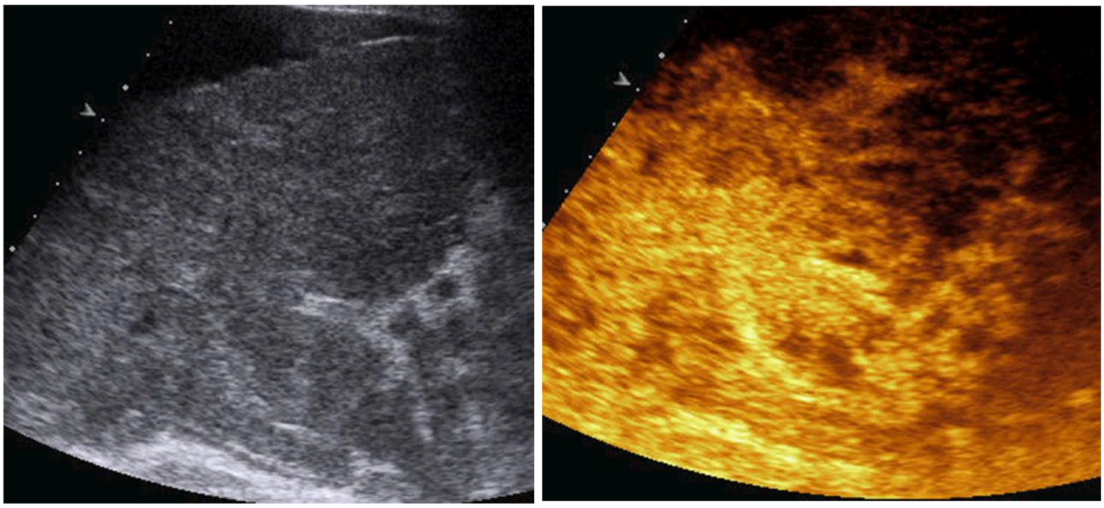


Fig. 4.3.92 a, b Tumour thrombus of portal vein, non-definable HCC of cirrhotic liver; FS right (b with CM, tumour thrombosis perfused)

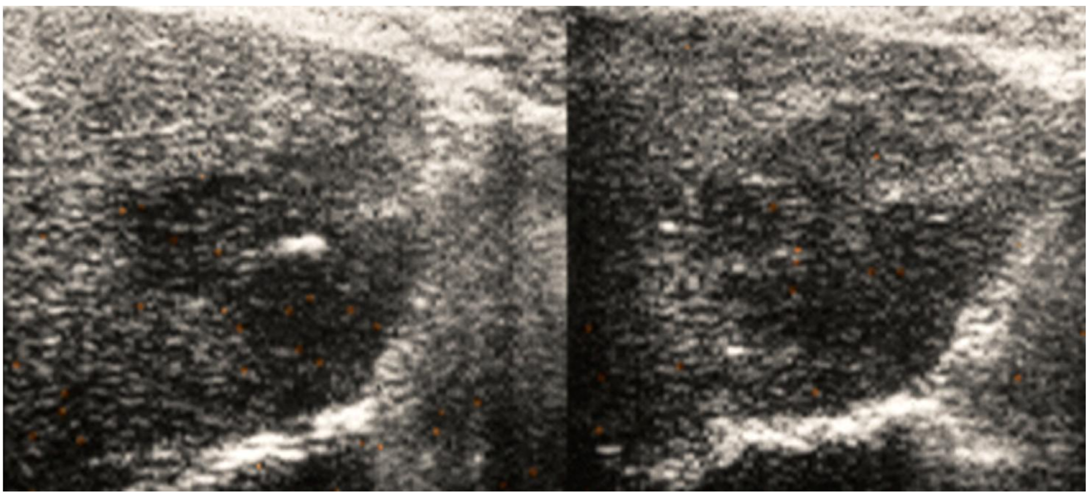


Fig. 4.3.93 a, b FL as a consequence of an infection with Brucella melitensis; UAS longitudinal

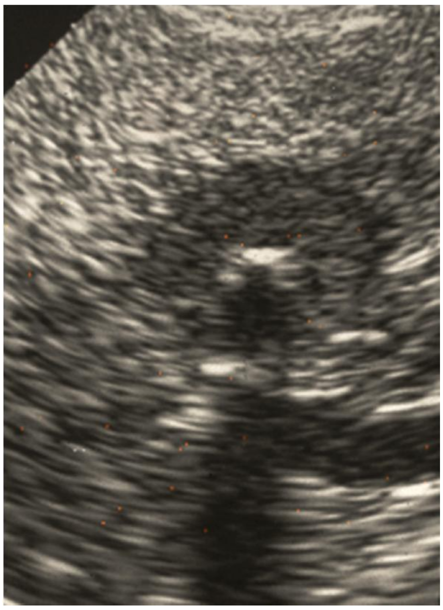
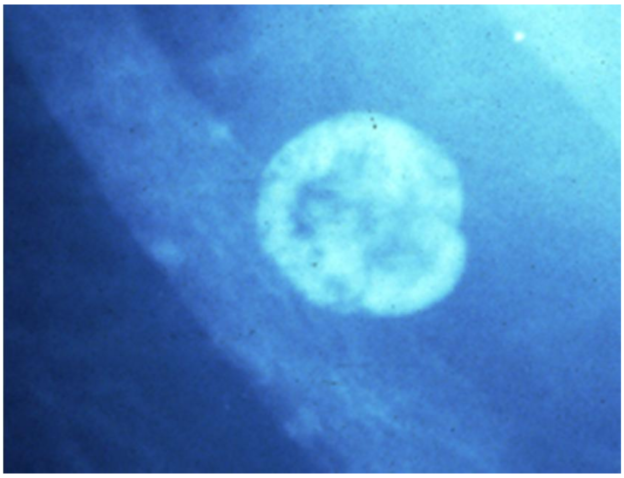



Fig. 4.3.94 a, b No FL, but sclero-atrophic cholecystitis; SCS right (a)

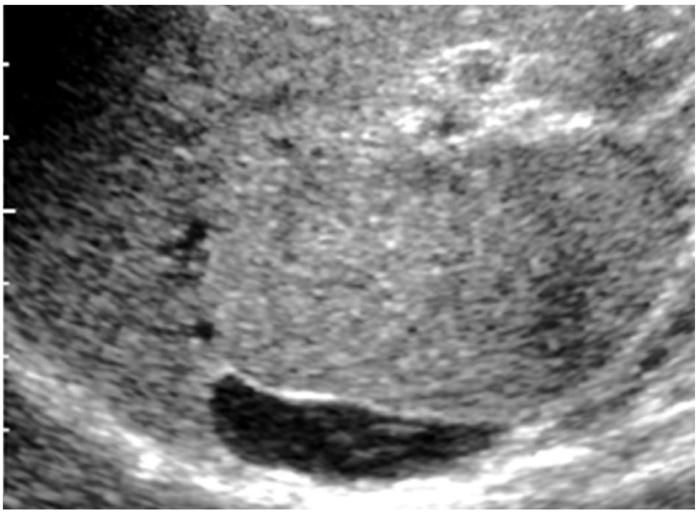


Fig. 4.3.95 Large FL (almost completely filling segment I), poorly detectable (almost isoechogenic); UAS longitudinal

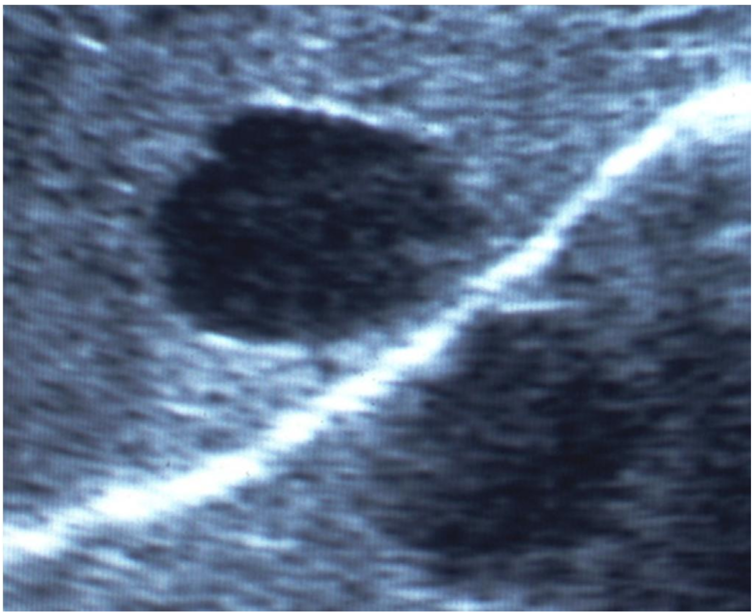


Fig. 4.3.96 FL right (clinical symptom-free hepatic cyst) with typical mirror artefact; SCS right

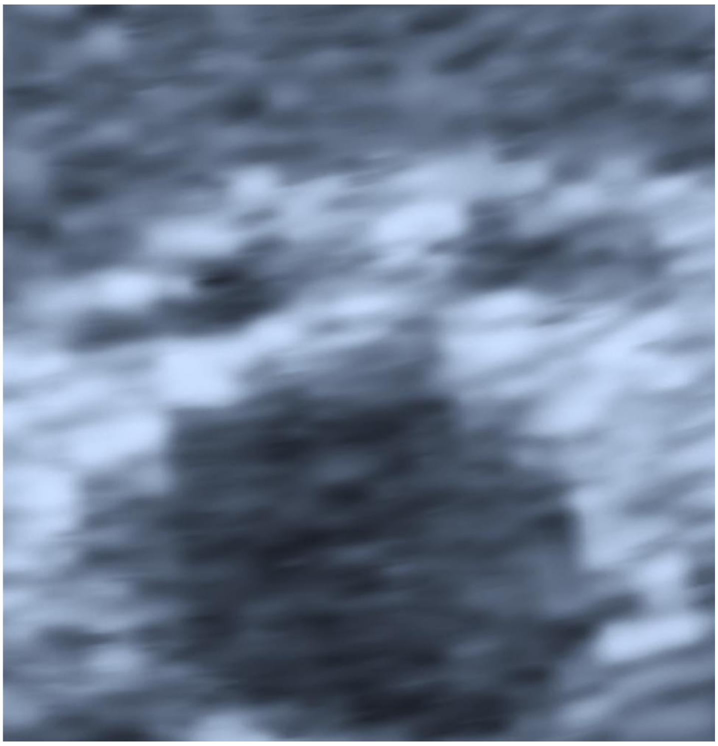


Fig. 4.3.97 Typical hilum: dorsal portal vein, right (seen from the examined) ventral hepatic bile duct, and left hepatic artery ("Mickey Mouse appearance"), normal medical findings, SCS right

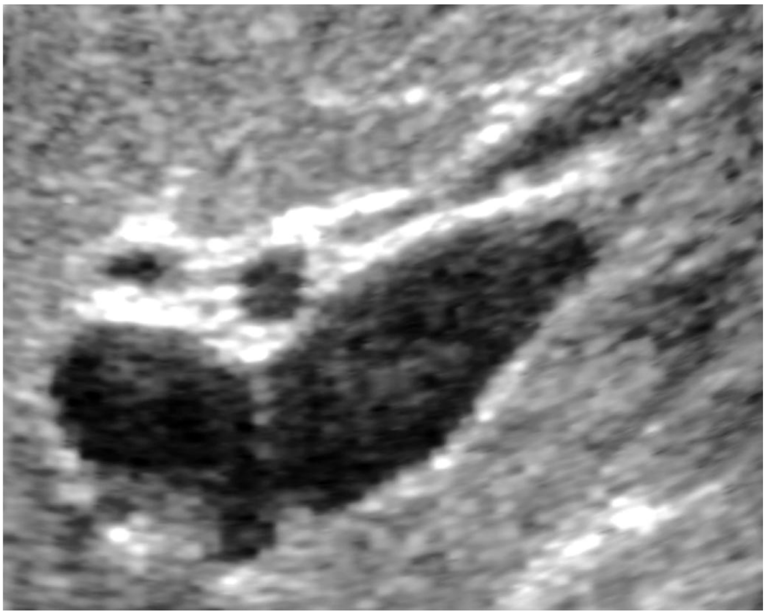


Fig. 4.3.98 Normal medical findings of liver porta with interjacent crossing of hepatic artery branch, not quite criteria of a genuine lymphadenopathy (not yet distorted normal echogenic and not enlarged lymph node); FS right

Fig. 4.3.99 Increased portal vessel reflexibility – advanced schistosomiasis (clinical acute haemorrhage of oesophageal varices); UAS longitudinal

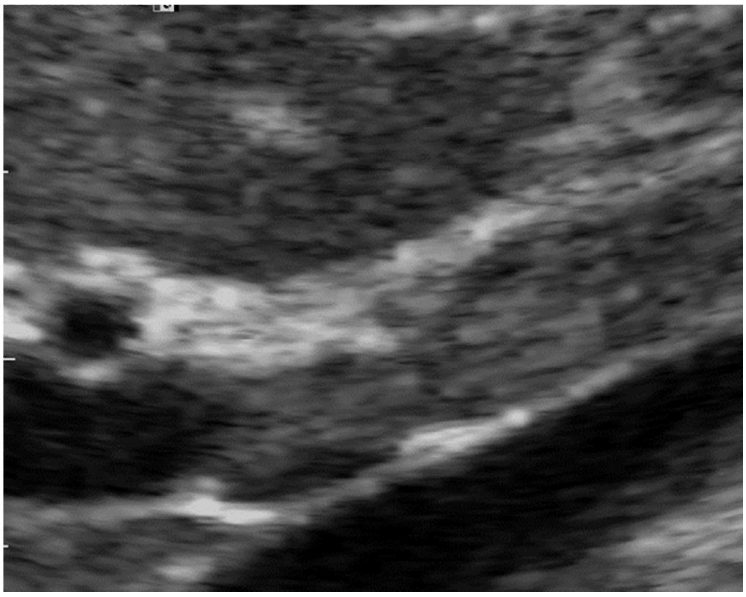


Fig. 4.3.100 Cholangiocarcinoma with occlusion of the almost isoechogenic hepatic bile duct (ventral area of the interjacent hepatic artery branch), partial thrombotic portal vein, normal inferior vena cava; FS right

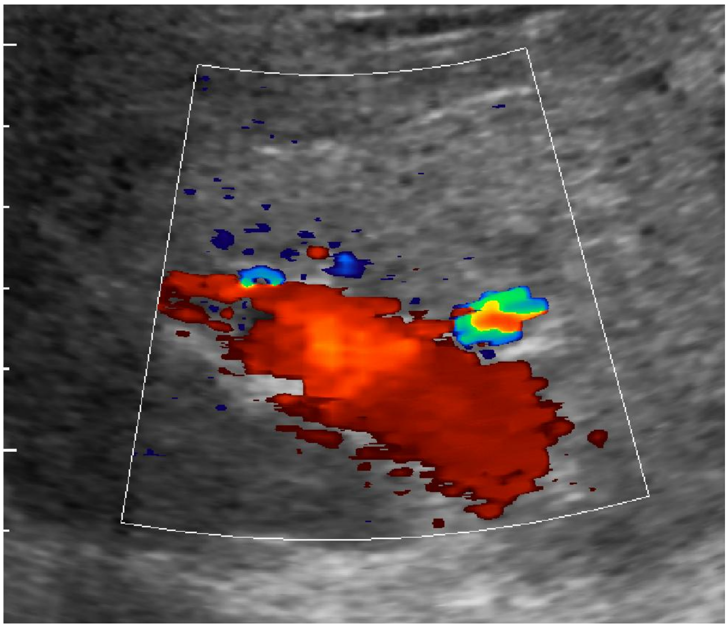


Fig. 4.3.101 Another case with HCC with typically interjacently crossing of the right hepatic artery branch; FS right

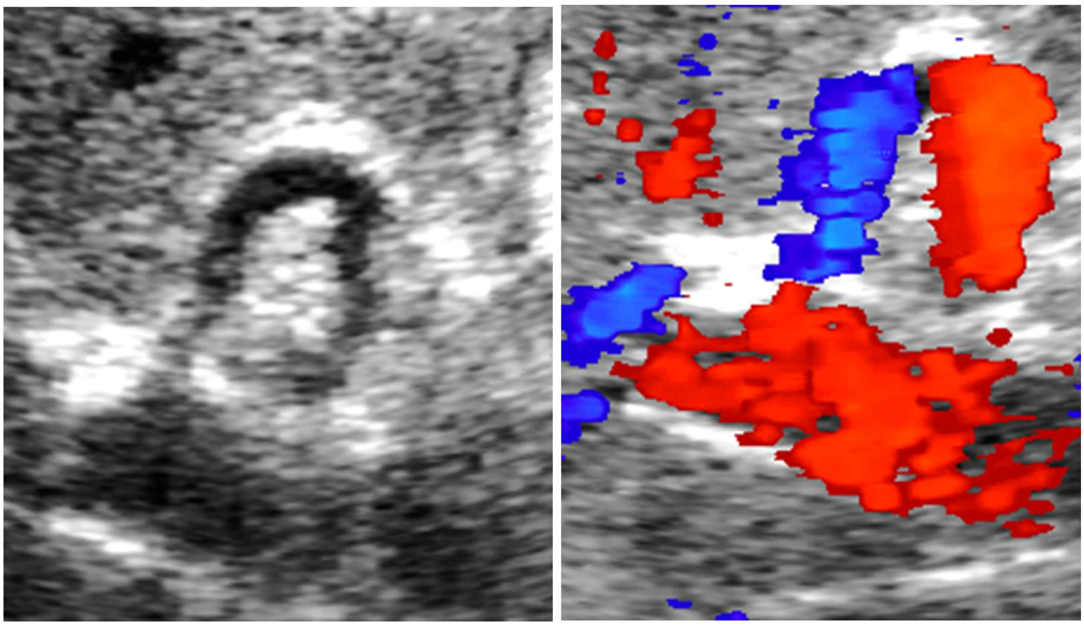


Fig. 4.3.102 a, b Variation of hepatic artery pathway; FS right (b with CCDS)

Fig. 4.3.103 HCC with unclear boundaries and pathognomic tumour thrombus invasion (arrows) of the hepatic bile duct; SCS right

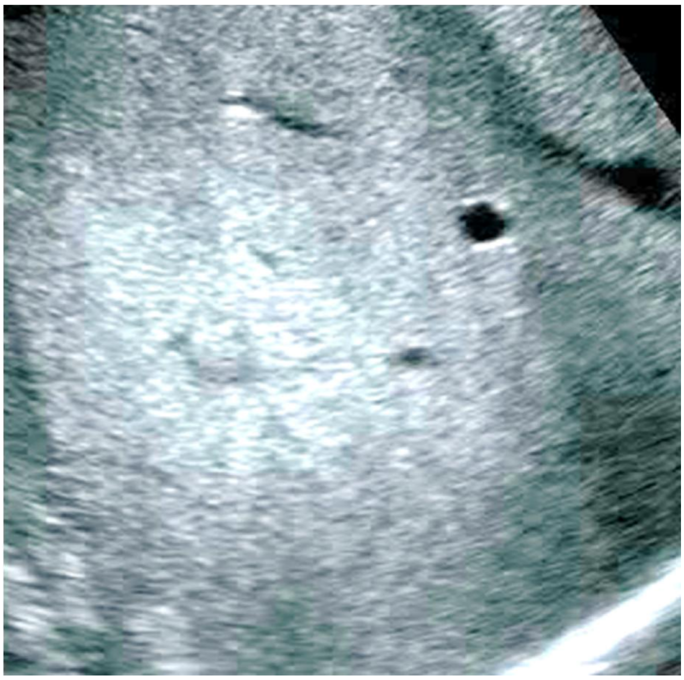


Fig. 4.3.104 Post-traumatic FL of the liver with abundant reflexes; SCS right

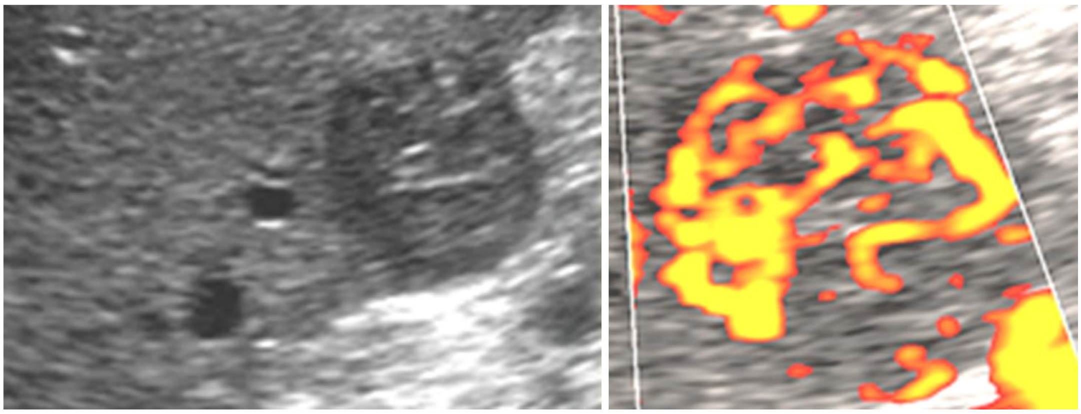


Fig. 4.3.105 a, b Hyperperfused and with pathological vessels vascularized liver tumour (clinical HCC in chronic hepatitis C); FS right ("power mode" sonography in b)

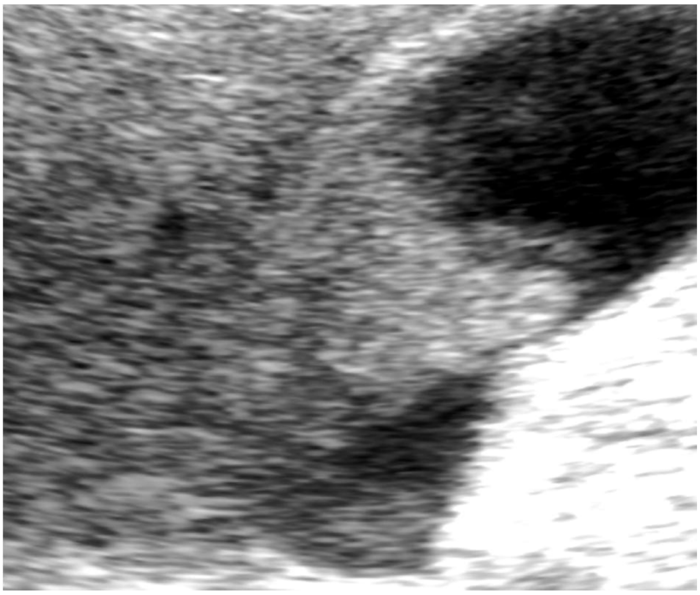


Fig. 4.3.106 Gallbladder invasive HCC; UAS longitudinal

Also in cases of diffuse liver changes ("fatty liver", cirrhosis) – an anyhow difficult chapter for sonography because of lacking objectiveness – problems can result, either from lacking morphological changes or from verbal difficulties describing it.

Changes due to inflammation, such as for example virus hepatitis often go along without sonographic conspicuities at most bile ducts and bile in particular are indicatively changed.

Fig. 4.3.107 Typical dyscrine bile fluid in acute virus hepatitis; unspecific complaints, spontaneous disappearance; SCS right

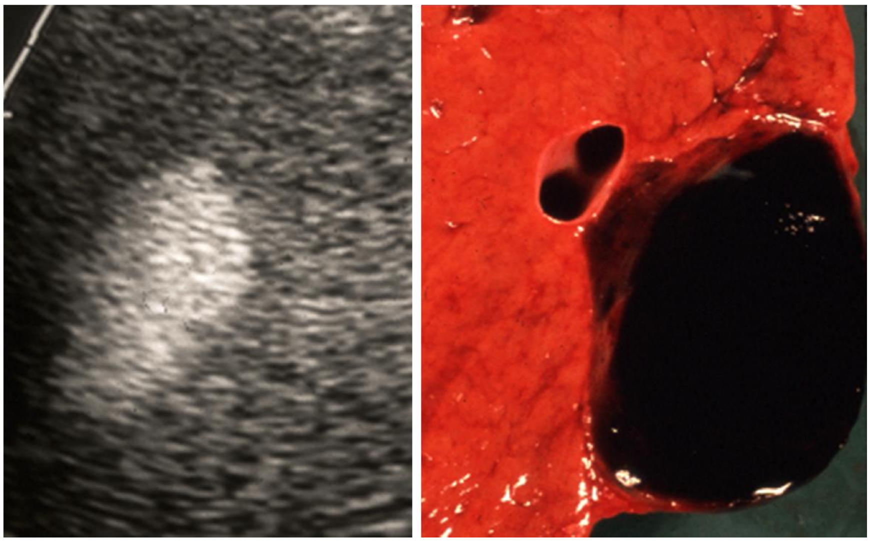


Fig. 4.3.108 a, b Hepatic haemangioma, SCS right (b surgical specimen)

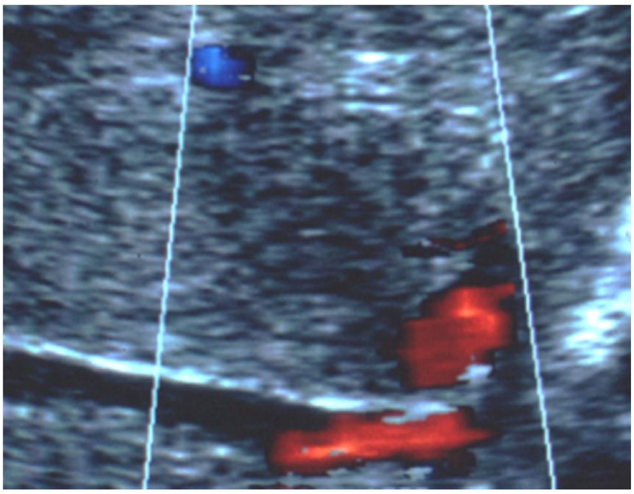


Fig. 4.3.109 Partially re-channelled Budd-Chiari occlusion of the liver; SCS with CCDS

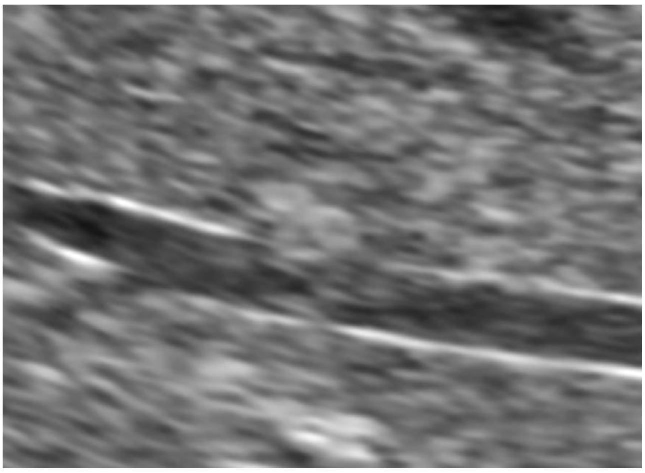


Fig. 4.3.110 Very small HCC proven by vessel invasion; SCS right

The ambiguity of "densification" of the "parenchymal pattern" (increase of "liver texture") is therefore subjected to a high degree of assessment subjectivity. Not always and exclusively are (chronic) inflammatory processes or infiltrations the correct explanation.

The often – probably too often – made and only somewhat "exact" histologically verifiable (suspected) diagnosis of a fatty liver elucidates exemplarily the lack of objectivity of sonography. This is a fact that is lessened by emerging objectifying possibilities (elastography), and is not necessarily to be interpreted negatively (as a reminder to "experience") – circumstances that will always accompany us.

Hepatic FL – a frequent incidental finding (about 15% of all examined) – are then a problem for ultrasound, if the lesions are small or close to the surface. Their exposure and closer investigation succeeds most of the time with CM or using puncture intervention, which however does not always go smoothly in the first attempt.

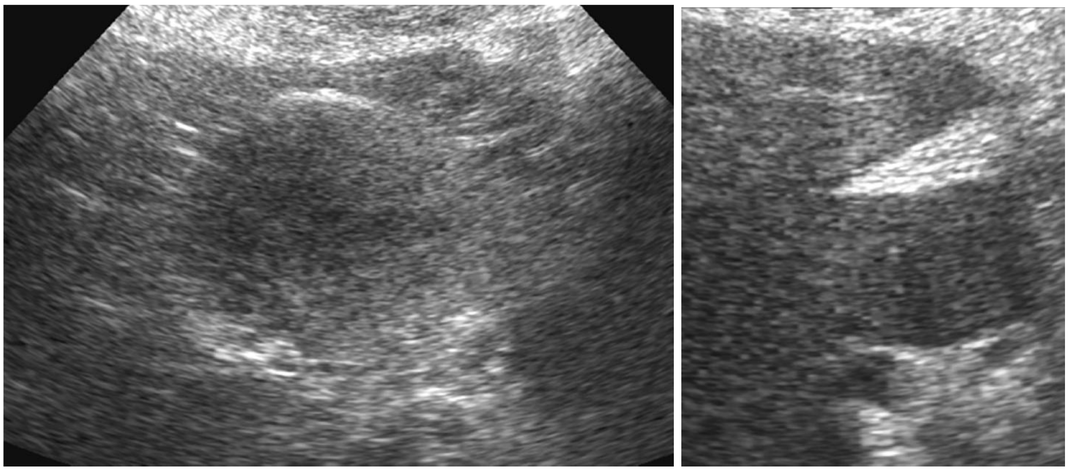


Fig. 4.3.111 a, b Apparent FL (in CT suspected malignoma) with accessory liver lobe; SCS right (a) and UAS transverse (b)

Fig. 4.3.112 Congested intra-hepatic veins and ascites, as well as small pleural effusion with right cardiac failure; SCS right. Planned puncture is forgone because of the suspected risk of bleeding, as well as the conducted echocardiography for diagnosis

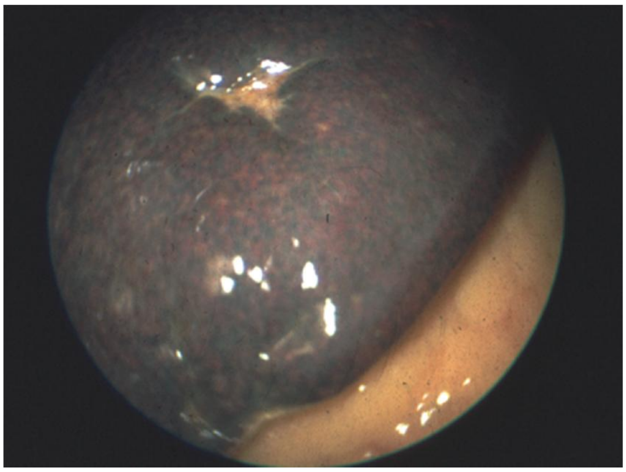


Fig. 4.3.113 Superficially located (and sonographically initially overlooked) malign FL; laparoscopic view

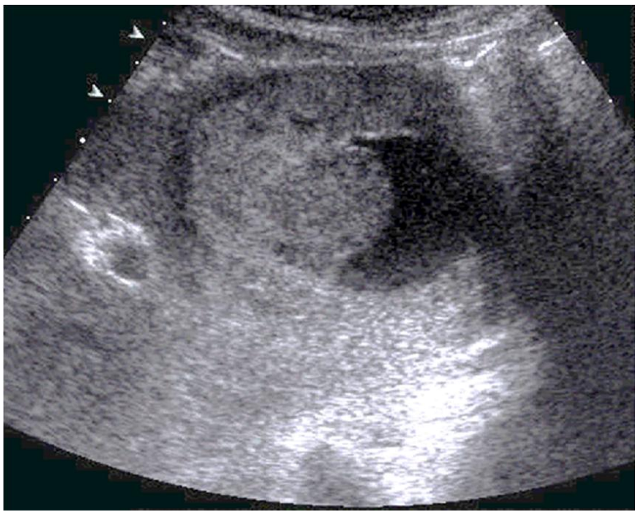


Fig. 4.3.114 Symptom poor liver metastasis of a neuroendocrine tumour with cystic involvement (verified diagnosis by sonography guided puncture); UAS transverse

Fig. 4.3.115 Highly reflexive kidney (clinically acute nephritis), FS right

The segment anatomy of the liver is easily comprehensible sonographically and is well suited to describe the approximate location of a FL.

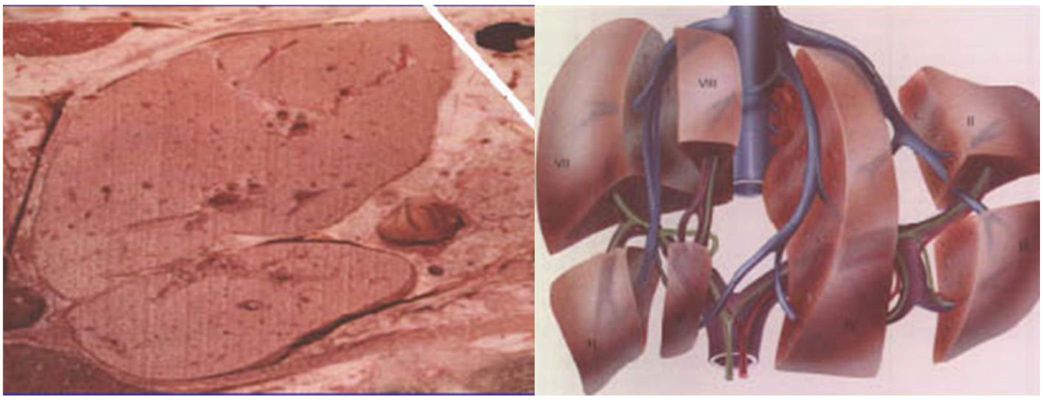


Fig. 4.3.116 a, b Current segment anatomy of the liver

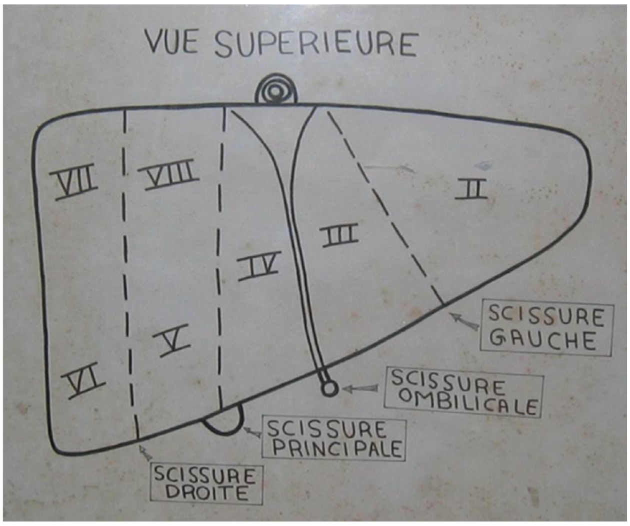


Fig. 4.3.117 No longer acknowledged very early segment anatomy of the liver

Please note:

- ***examine all segments***
- ***make an ultrasound of several segments***
- ***honour colour-coded duplex and contrast medium examination***
- ***conduct elastography***
- ***puncture, if in doubt***

4.4 Bile Ducts

Fig. 4.4.01 Extravascular coagulation congests the hepatic bile duct; FS right

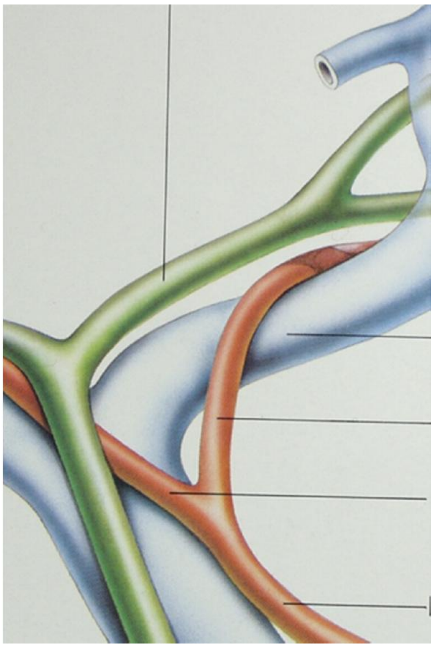


Fig. 4.4.02 Vessel structures of the portal liver (beginning of Glisson's triad)

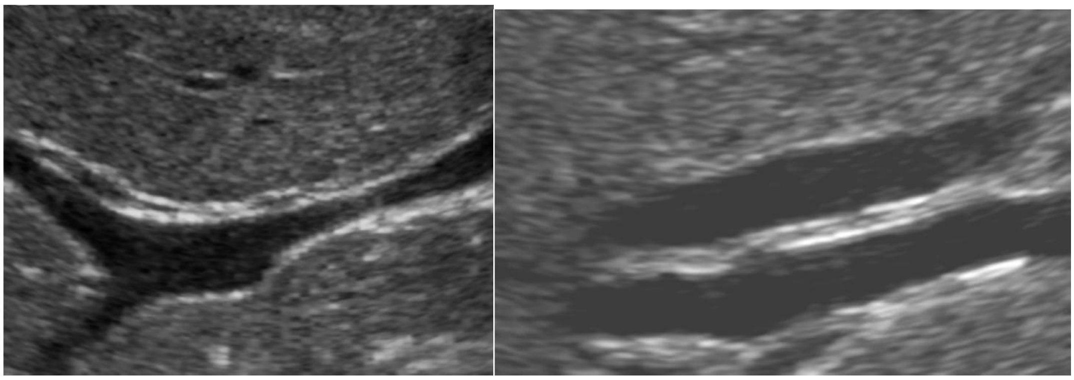


Fig. 4.4.03 a, b Typically situated normal hepatic bifurcation ventral to portal vein bifurcation, SCS (a); as well as - in another case (b, UAS transverse) - massive dilatation and depiction of a centrally situated associated branch of the hepatic artery (a) ("triple-barrelled shotgun phenomenon"); significantly dilated intrahepatic bile ducts also ventral (segment III) of the accompanying and somewhat more prominent portal vessel ramification (Glisson's triad!); the dilatation is detected easier by optical perception than by measurement; SCS right and UAS transverse (b); (b: segment III with ramification of ventral bile ducts, vice versa in segment II) (two different cases)

The bile ducts are intrahepatically already in normal condition – particularly in their "sonography friendly" stretched position and transducer parallel pathway in the left liver lobe – good for peripheral differentiation. During congestion the intrahepatic bile duct branches are especially well visible. Also without problems the unilateral not (yet) hyperbilirubinemic bile duct extension of the intrahepatic bile ducts can be easily unmasked.

The detection of biliary outflow obstruction level and its cause – the essential questions in this situation – is easily done by sonography as a rule.

Imaging of the liver porta with its complex structures succeeds here according to rule – portal vein, common hepatic bile duct (DHC) and right branch ("interjacent crossing") of the hepatic artery are easily depicted. Although sometimes even the "experienced" have their difficulties with this: The section pattern ("portal section") is individually adapted in supine position, better is the left lateral position (using the right liver lobe as "viewing window" in deep inspiration).

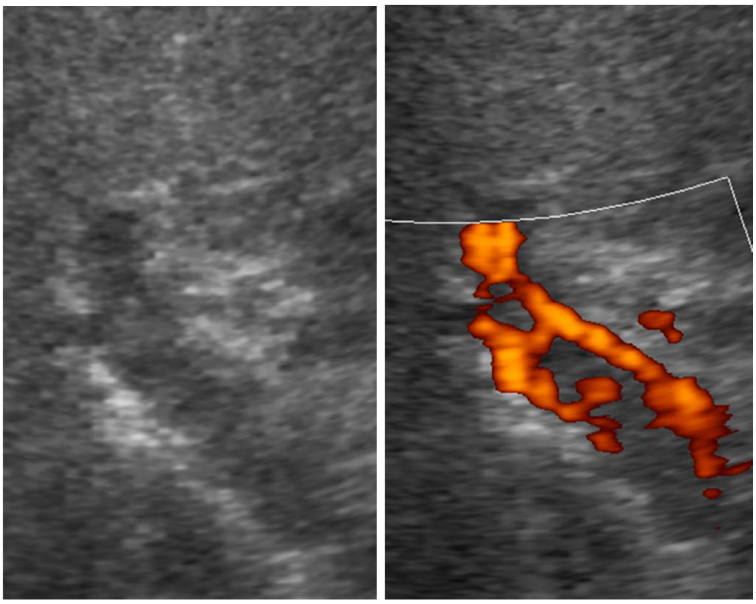


Fig. 4.4.04 a, b Portal venous thrombosis; FS right (b with CCDS)

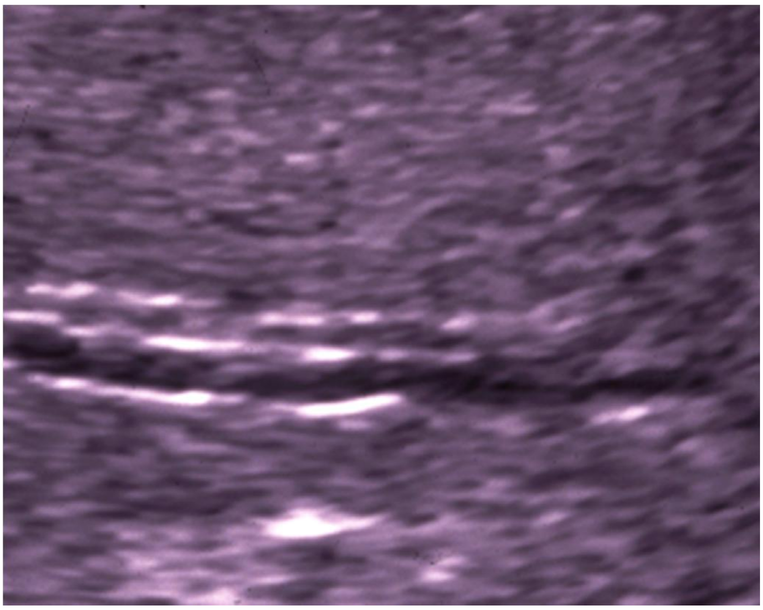


Fig. 4.4.05 Slightly dilated intrahepatic bile ducts in segment III; UAS transverse

The fact that smooth muscle fibres are lacking in the hepatic bile duct has decisive practical consequences with respect to pressure elevations of any genesis within: The response in the bile ducts is an immediate dilatation. In contrast to the strong muscular ureter, the bile duct responds even to minor pressure increases without delay (which is on the other hand less pronounced in cirrhotic induration).

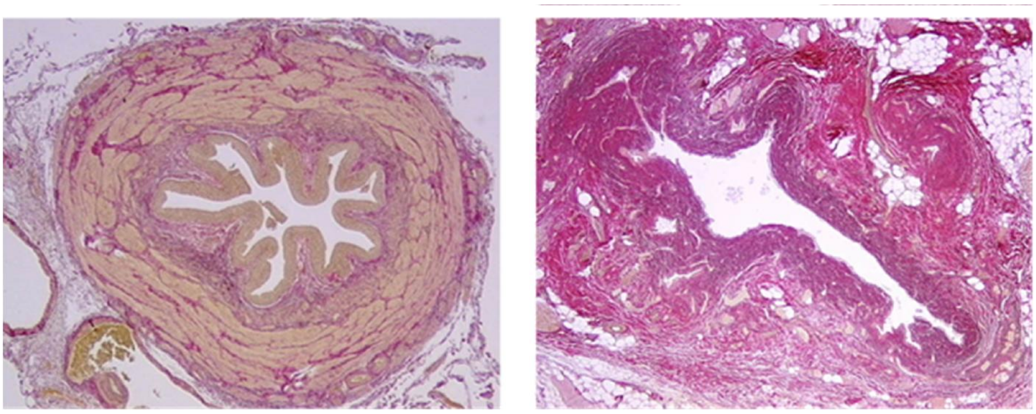


Fig. 4.4.06 a, b Strong muscular ureter (a), and almost muscle free hepatic bile duct (b); the smooth muscle fibres are yellowish in the haematoxylin and eosin stain

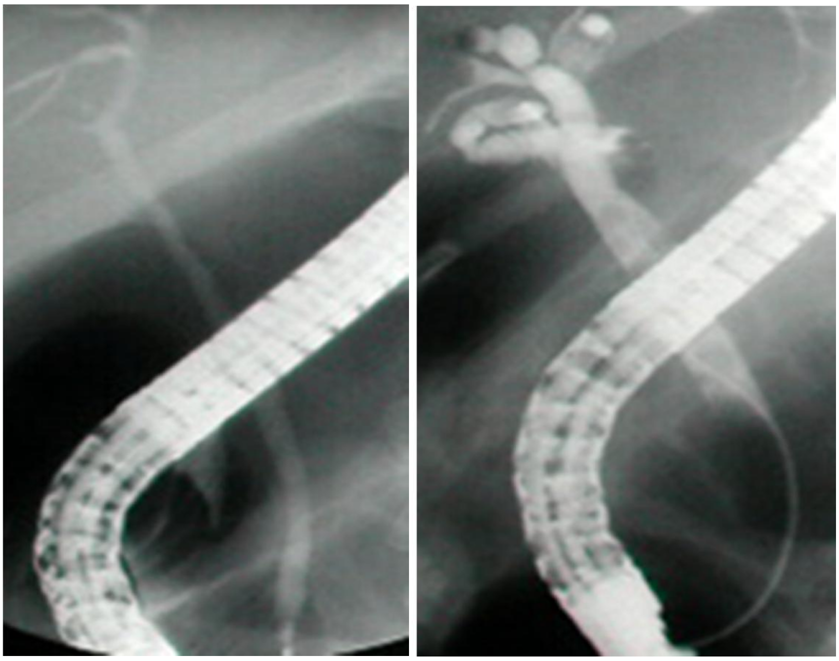


Fig. 4.4.07 a, b After minimal CM injection already dilated (b) hepatic bile duct; ERCP

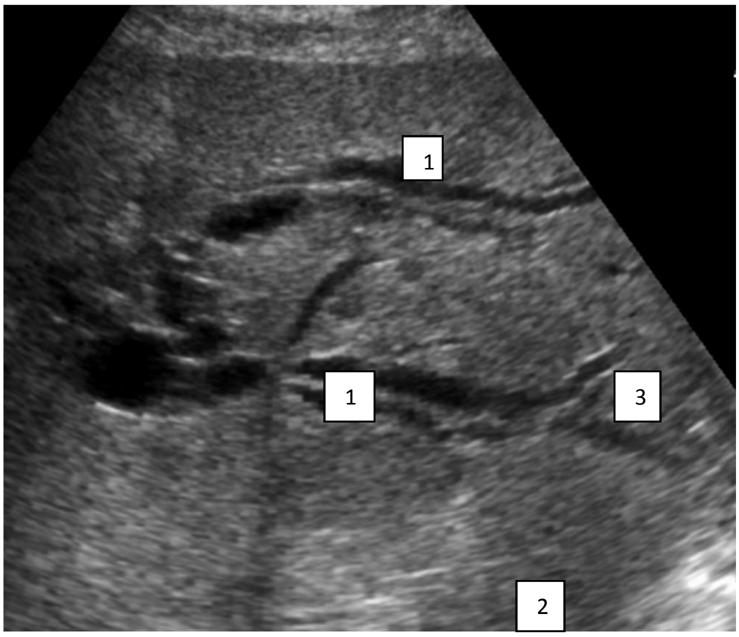


Fig. 4.4.08 Over a longer period of time completely congested intrahepatic bile ducts (segment II at 1, segment III at 2/3) ("double-barrelled shotgun phenomenon") (small Y inside: bile duct ramifications, large outer Y: portal vessel ramifications); UAS transverse

Bile duct morphology betrays – irrespective of its general or unilateral dilatation – a lot regarding the duration of congestion: Slowly developing stenoses are more markedly dilated and tortuous than sudden complete bile duct occlusions.

Merely circumscribed bile duct additions are mostly accompanied by a lack of hyperbilirubinemia (but elevated "liver values").

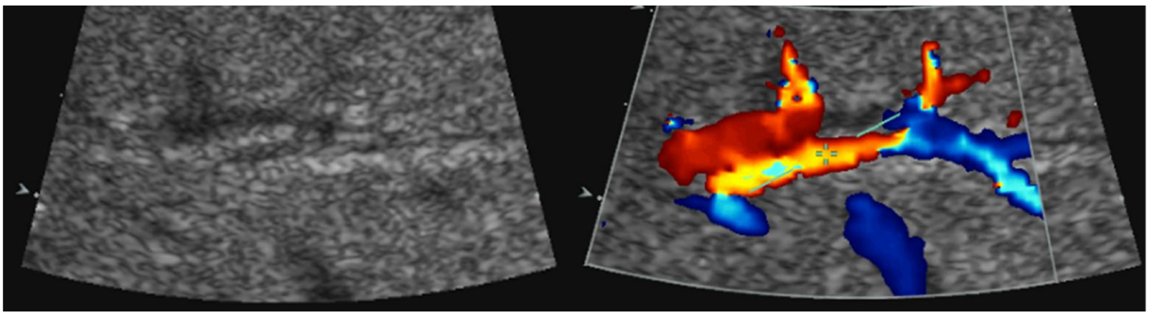


Fig. 4.4.09 a, b Hepatic artery branches can give the misleading impression of congested and dilated bile ducts, especially in liver cirrhosis with hyperperfusion; SCS (b with CCDS)

Already few intact liver segments are sufficient for this, especially in the slow development of isolated stenosis, as it is by far not atypical for CCC.

Sometimes biliodynamic ineffective stenoses cannot be discovered sonographically, but also the deep seated cystic duct inlet can lead sonographically to a supposed dilatation diagnosis by mistake.

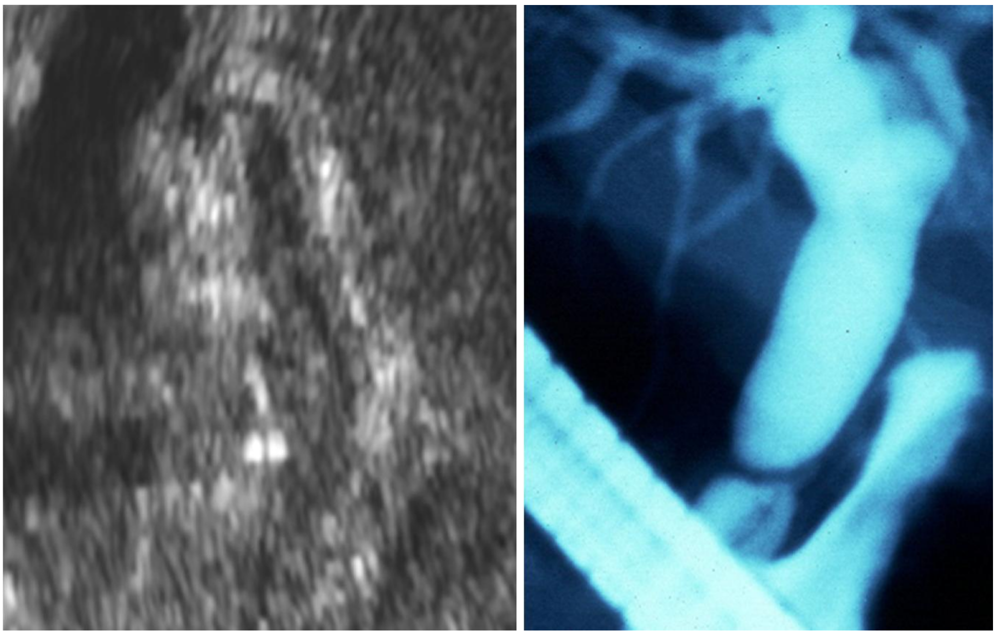


Fig 4.4.10 a, b Irrelevant biliodynamic clip stenosis after cholecystectomy; SCS (a turned by 90 degrees, b ERCP)

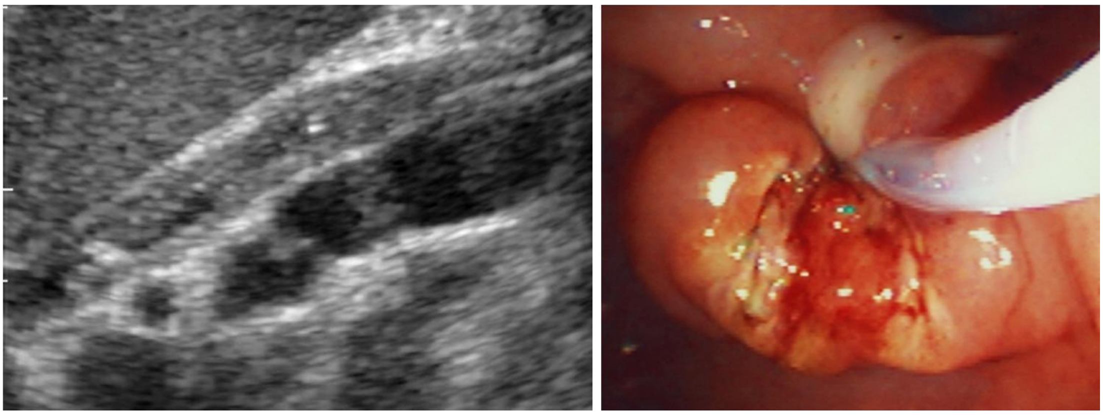


Fig. 4.4.11 a, b Biliary duct hypertrophy (above the 1 mm upper normal limit for wall thickness) after purulent lithogenic cholangitis and EPT (b); FS right (note the typical interjacent branch of the right hepatic artery in (a))

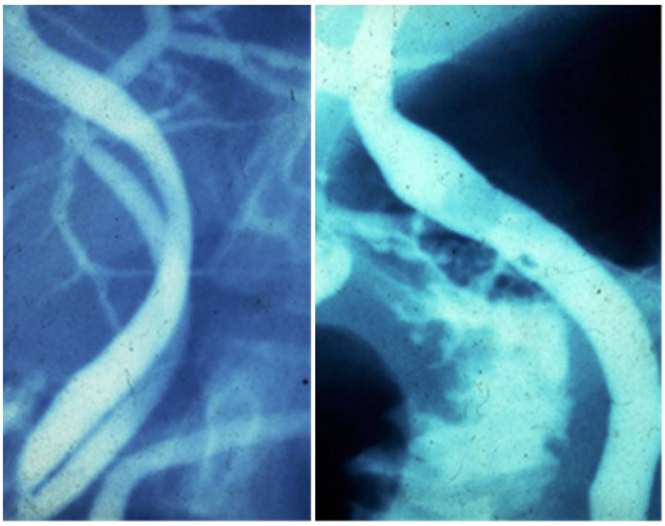


Fig. 4.4.12 a, b	Deep cystic duct inlet (with false diagnosis of extrahepatic bile duct dilatation), as well as orthograde inlet shape of the cystic duct (a) (with false diagnosis of a choledocholithiasis); ERCP (different cases)

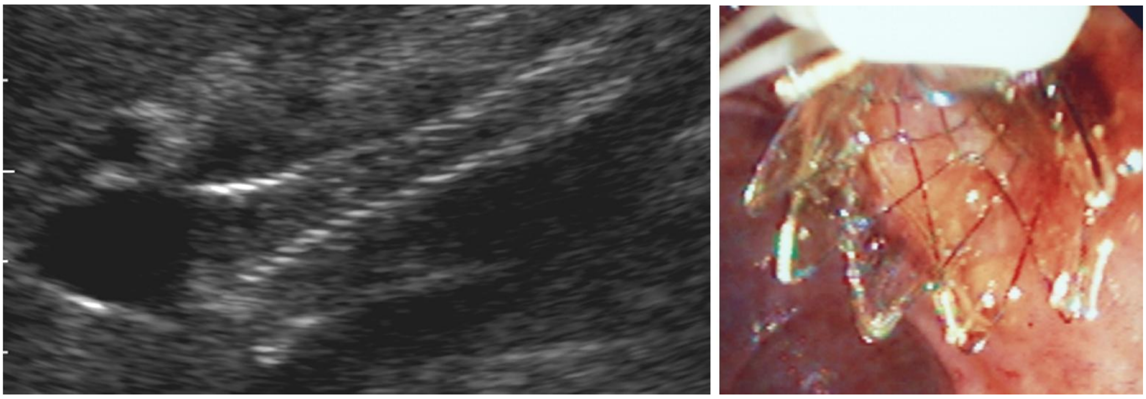


Fig. 4.4.13 a, b	Clogged self-expanding (metal) stent; FS right

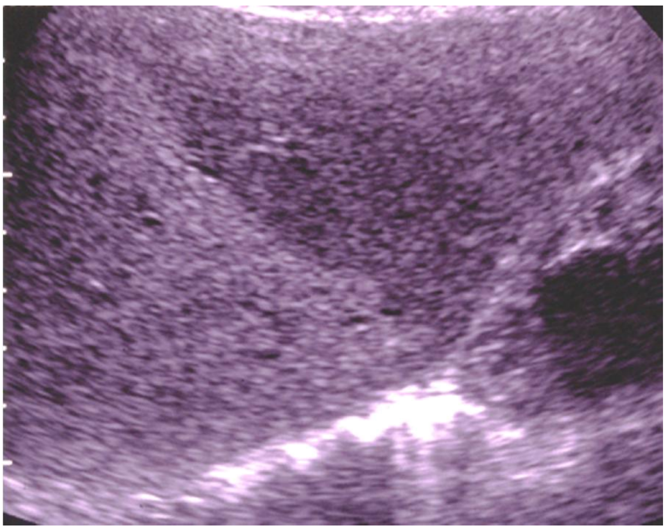


Fig. 4.4.14	Unilateral biliary congestion by sinistral bile duct cancer evading direct sonographic imaging; SCS right

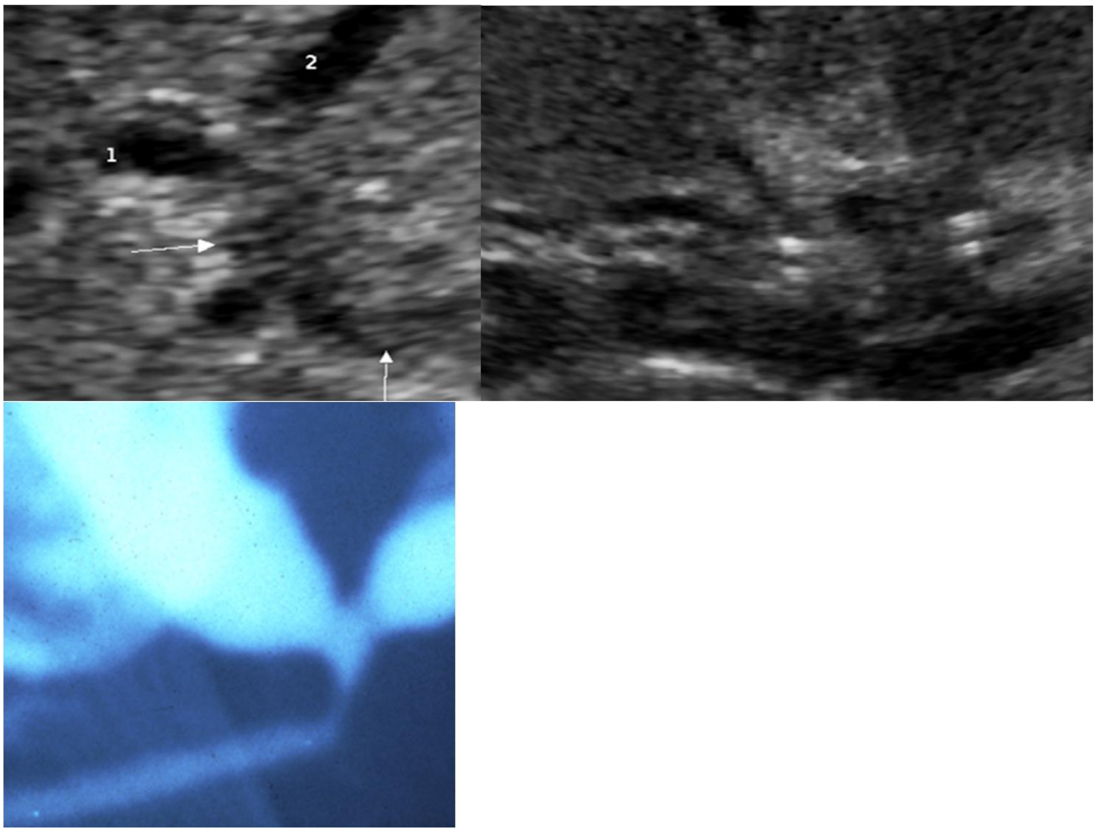


Fig. 4.4.15 a-c Verifiable Klatskin´s tumour isoechogenic to hepatic tissue (arrows): CCC in portal position before (a, c), and after double-sided stent application (b, c) of right (1) and left (2) hepatic branch (non-invasive check-up examinations!); SCS right

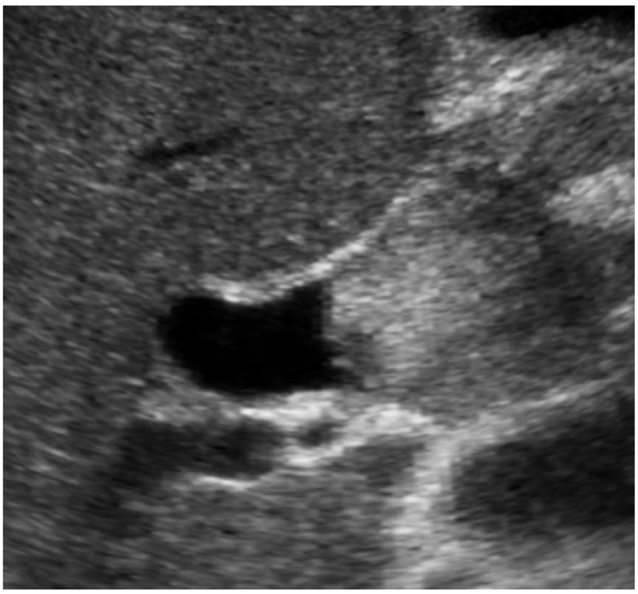


Fig. 4.4.16 Cholangiocarcinoma with congested hepatic bile duct, as well as (short distance) representation of portal vein and interjacent crossing of the right hepatic artery branch; FS right

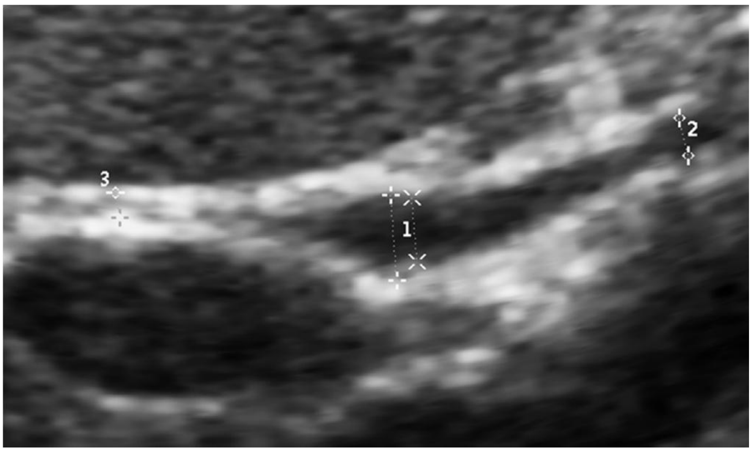


Fig. 4.4.17 Differing measurement values in cholangiectasis (normal findings) - 1 = 9 and 7, as well as 2 = 5, 3 = 2 mm; FS right

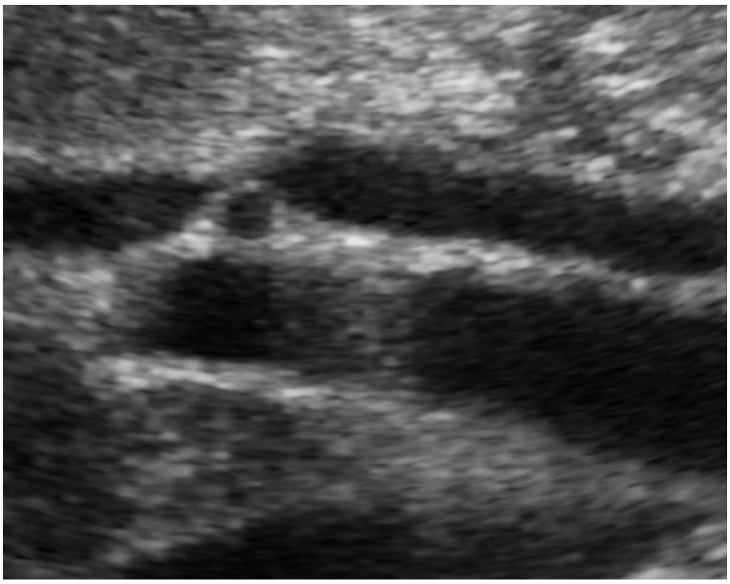


Fig. 4.4.18 Normal impressible bile duct and portal liver structures (safe exclusion of biliary congestion); FS right

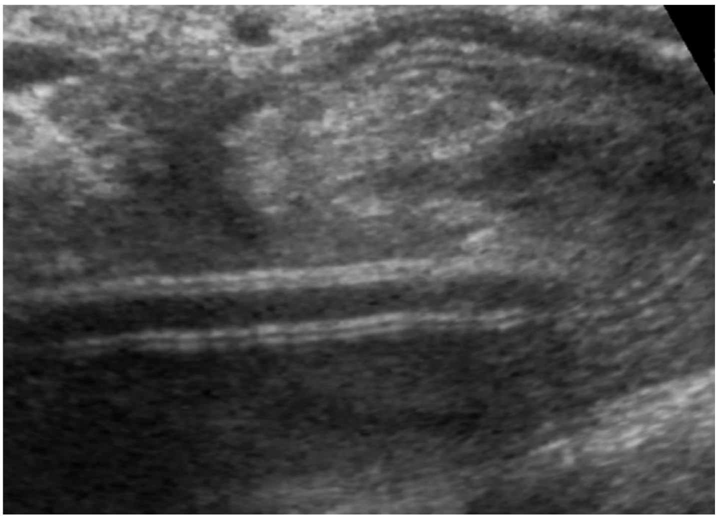


Fig 4.4.19 Well-draining bilio-duodenal stent, verifiable transpapillary to course in duodenum; FS right (with high resolution transducer)

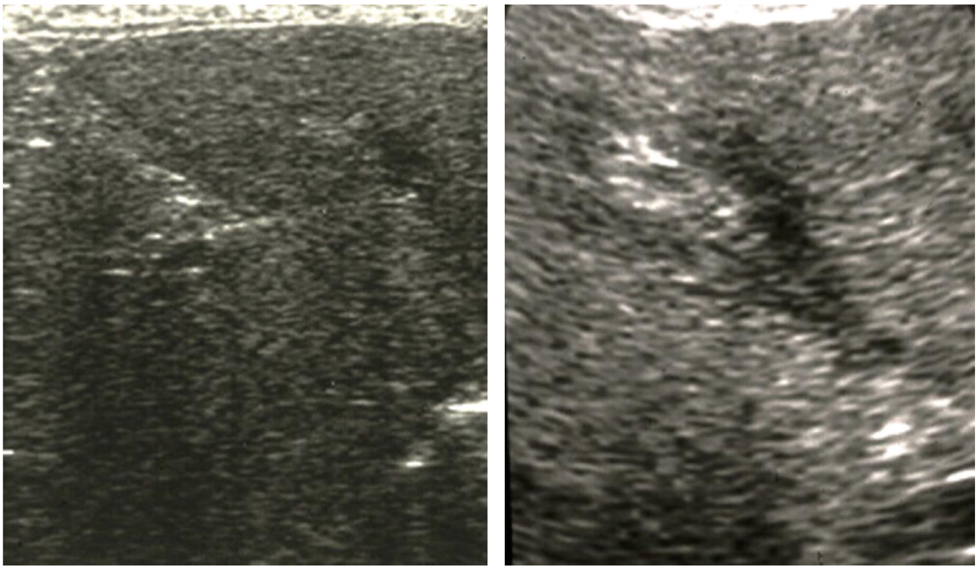


Fig 4.4.20 a, b Scars after cholecystectomy years ago; SCS right (two different cases)

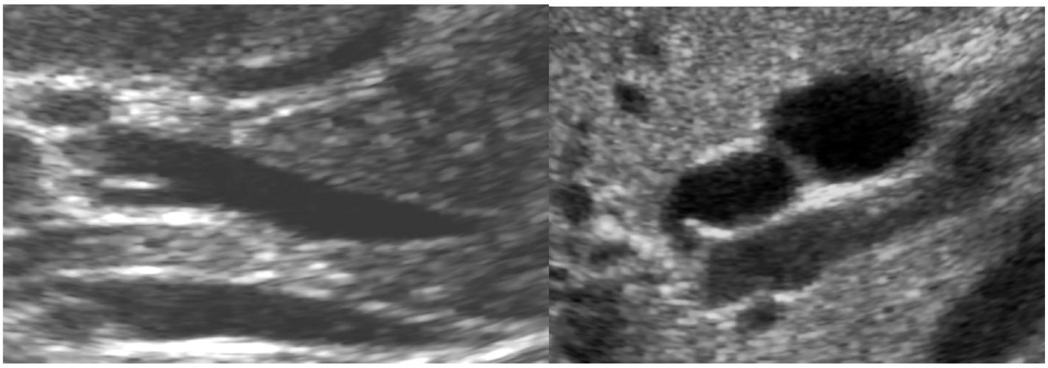


Fig. 4.4.21 a, b Two different cases of congested (dilated) cystic duct trunk, normal lymph nodes, interjacent branch of hepatic artery truncated sections (a); FS right

The hepatic bile duct (DHC) has a normal width of 5 (-7) mm, and is often expanded after cholecystectomy. It is remarked here critically, that the bile duct frequently increases in diameter with increasing age of the examined – and long after surgical removal of the gallbladder this means also automatically an advanced age.

For choledocholithiasis it holds true that about 50% of the DHC stones are found to be asymptomatic or in a bile duct with normal width, and that for small stones always an additional search for further stones in the DHC should be conducted (especially with elevated cholestasis parameters – which however, in contrast to sonography with immediate proof of dilatation, needs several to many hours of congestion to increase – and with typical history).

In PSC two types of changes are to be paid attention to: highly suspicious segmental hypertrophy of the DHC wall, intrahepatic presence of – mostly in irregular segments – little to at most moderately expanded bile duct sections with concomitant fibrotic changes. If solid space occupations are visible in addition to these changes, presence of a CCC can be suspected.

In principle, forms of cholangitis cannot be reliably distinguished by sonography from other forms, such as schistosomiasis. They all have in common sonographically tangible fibrotic changes of periportal areas.

Well recognizable are pre-stenotic bile duct dilatations and cholangitic abscesses. Aerobilia without surgical intervention at the bile duct system or without EPT is a clear indication of a bacterial cholangitis with gas-forming bacteria, as well as a spontaneous gallstone perforation.

Contrast medium enhanced sonography (CEUS) allows better recognition, and differentiation from cholangitic abscesses and from CCC.

Fig. 4.4.22 Bile duct fragments after biliary extracorporeal shock wave lithotripsy (ESWL), portal vein, and normal inferior vena cava, as well as the interjacent hepatic artery branch, FS right

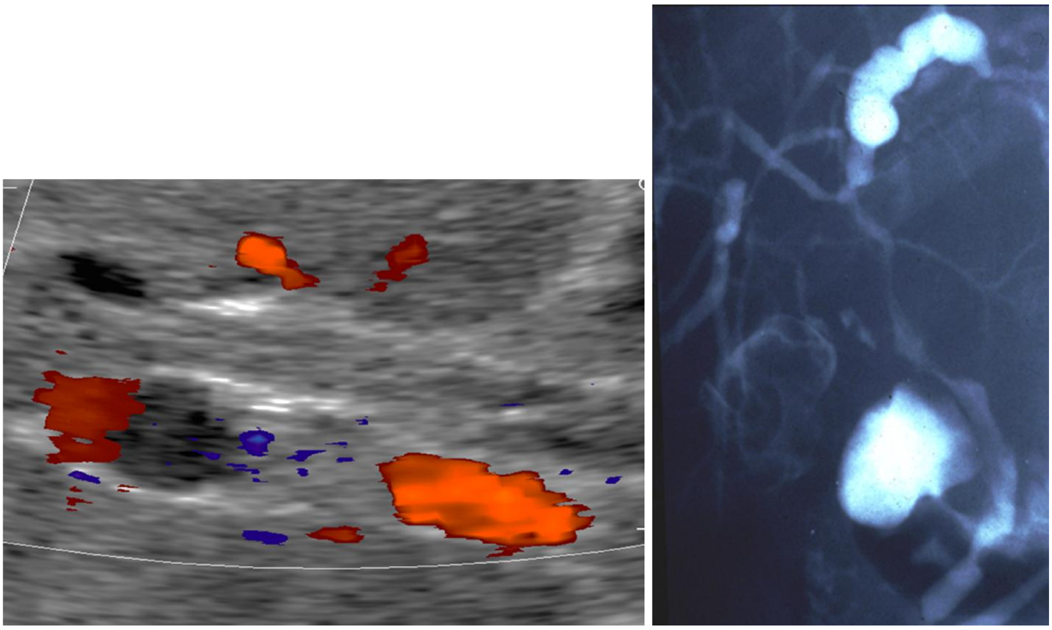


Fig. 4.4.23 a, b Hypertrophy-inducing and stenosing PSC, extrahepatic (a) and intrahepatic (b) with classic lymphadenopathy; FS right (a)

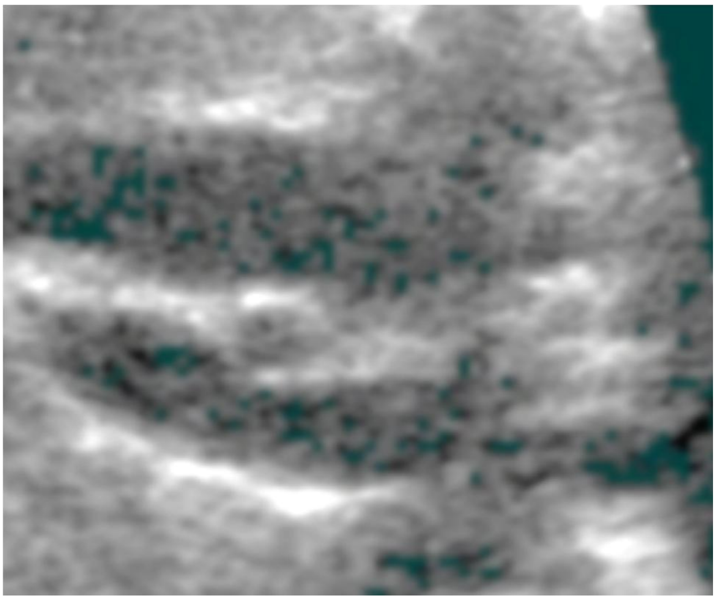


Fig. 4.4.24 Moderately congested hepatic bile duct, typical interjacent hepatic artery branch (clinical occluding pancreas head cancer); FS right

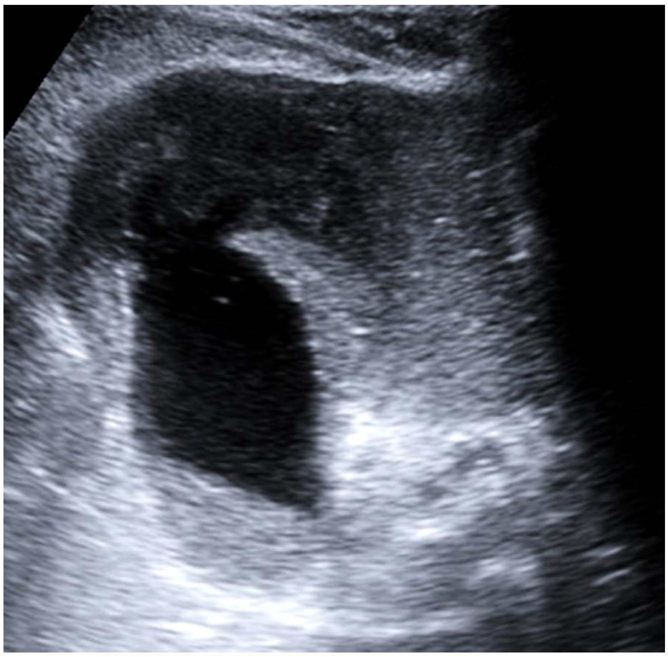


Fig. 4.4.25 Acute cholecystitis with gallbladder perforation and sludge; SCS right

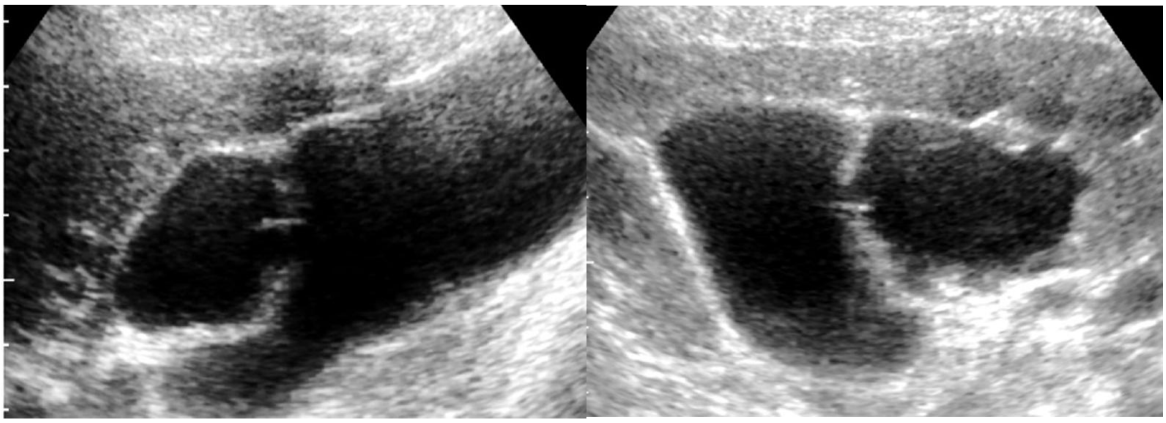


Fig. 4.4.26 a, b Acute cholecystitis with covered perforation (arrows); LS (a) or SCS right (b)

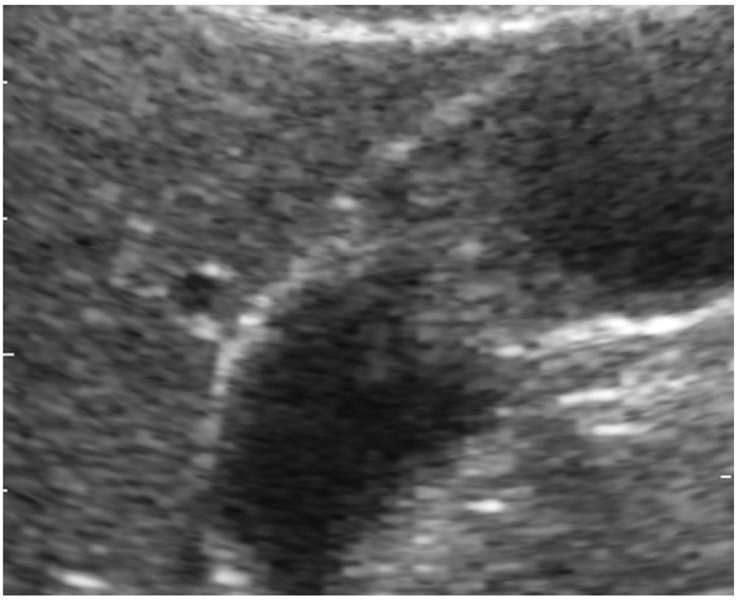


Fig. 4.4.27 Segmental adenomyomatosis; LS

Effective bile duct stenoses become obvious, if they are of "biliodynamic relevance", by the preceding bile duct dilatation. For the imaging of an only short section of bile duct stenosis, percutaneous sonography is only sufficient in exceptional cases. The use of a higher frequency transducer is to be aimed at. The clearly recognizable findings are localized at the hepatic bile duct and are mostly a consequence of a complicated laparoscopic cholecystectomy. A CCC has to be always excluded by differential diagnosis. The diagnostic method of choice is CEUS, possibly also intracavitary ultrasound via ERC.

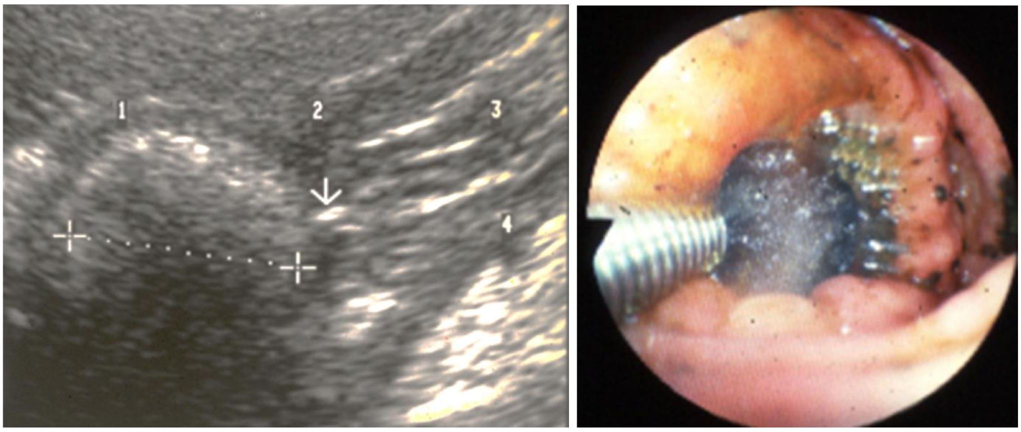


Fig. 4.4.28 a, b Former gall stone stranded in bulb (between measurement crosses) (oesophageal rupture, Boerhave syndrome), gas in the pyloric channel (arrow), 1 = bulb, 2 = antrum anterior wall, 3 = luminal antral mucosa, 4 = antrum posterior wall; UAS transverse (a), (endoscopic transpyloric view in b)

The question of gallstones is answered by sonography with increasing experience to a verifiable extent or at least indicatively, even under difficult conditions.

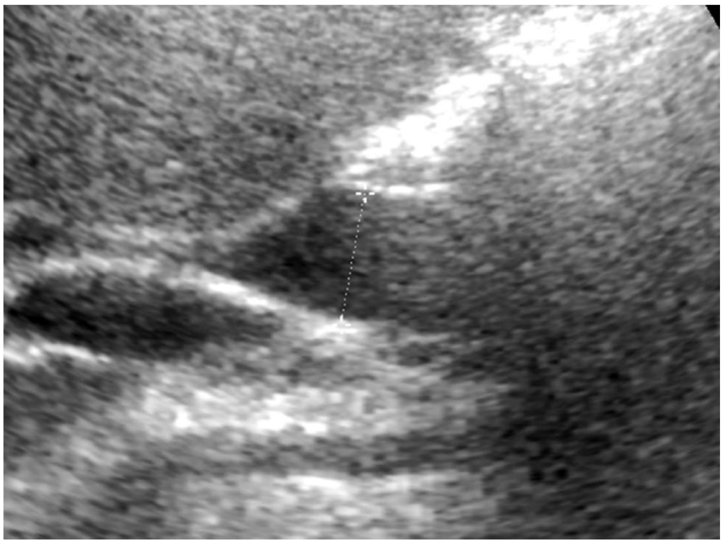


Fig. 4.4.29 Normal hepatic bile duct, age-typical slight prepapillary ectasia (between measurement crosses, often - especially in the elder patients - beyond the designated 7 mm normal upper limit), hepatic artery branch and portal vein, as well as normal inferior vena cava; FS right

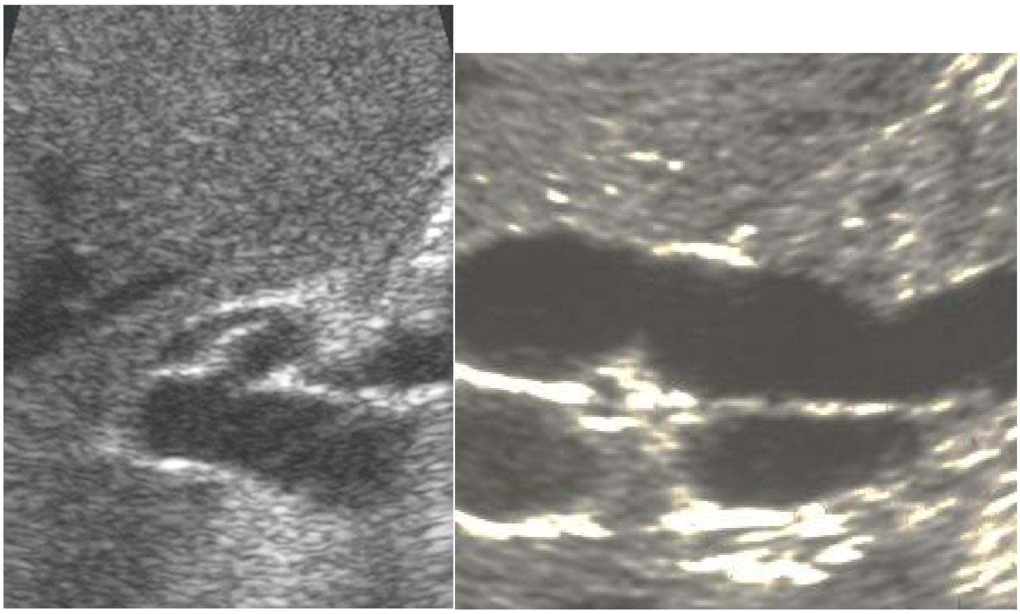


Fig. 4.4.30 a, b   Normal-sized (a) and easily impressionable prepapillary minimally manifest ectatic DHC, as well as – in another case (b) – slightly congested (dilated) DHC, in both cases with typical interjacent branch of the hepatic artery (in a slightly ectatic) ventral to portal vein; FS right; two different cases

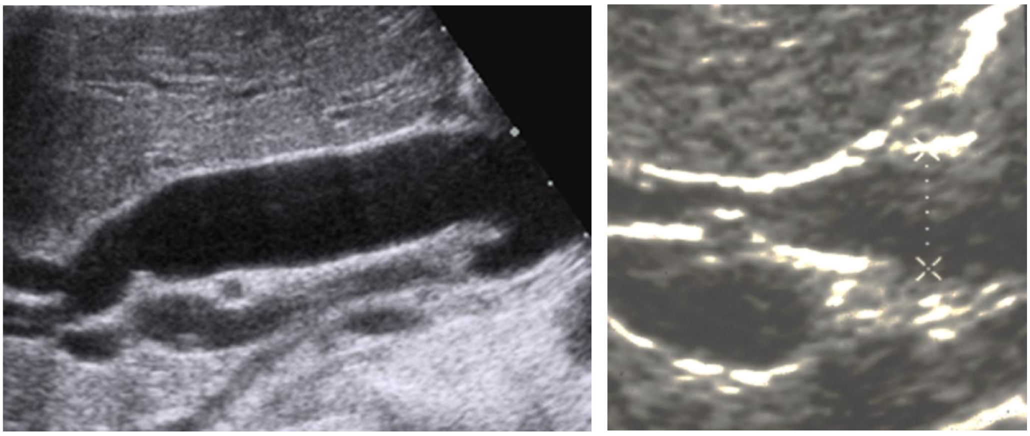


Fig. 4.4.31 a, b   Over a longer period congested hepatic bile duct (b, lithogenic occlusion), dilated cystic duct trunk (a), dorsally: diaphragm, right renal artery, inferior vena cava, portal vein, interjacent branch of hepatic artery as well as portal vein and normal liver; FS right

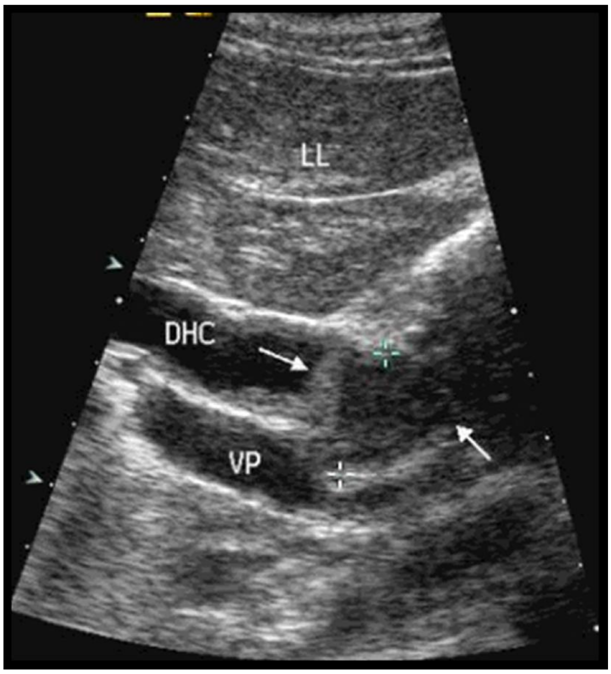


Fig. 4.4.32 Ultimately malign occlusion of the hepatic bile duct (DHC, arrows and measuring crosses), portal vein (VP), and interjacent right branch of the hepatic artery (lower measurement cross), left liver lobe (LL); FS right

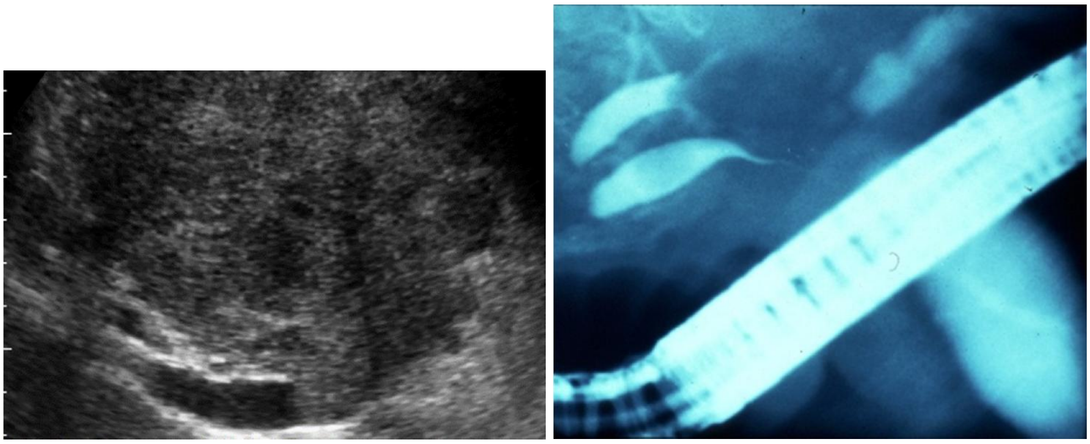


Fig. 4.4.33 a, b Huge lymph node metastasis (clinically one year after surgery of a colorectal carcinoma) with invasion into portal vein, impression of hepatic bile duct, interjacent right branch of hepatic artery,; FS right (a) or ERCP aspect

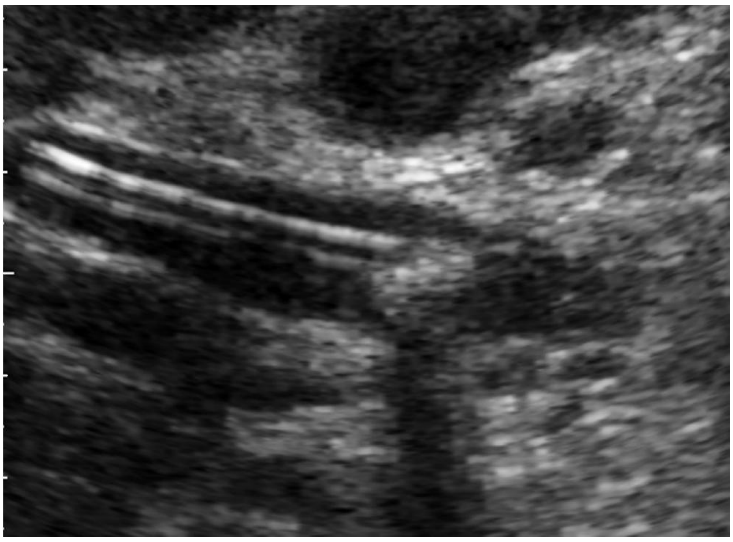


Fig. 4.4.34 Calculus and towards hepatic bifurcation dislodged stent in DHC moderately congested by malignoma; FS right

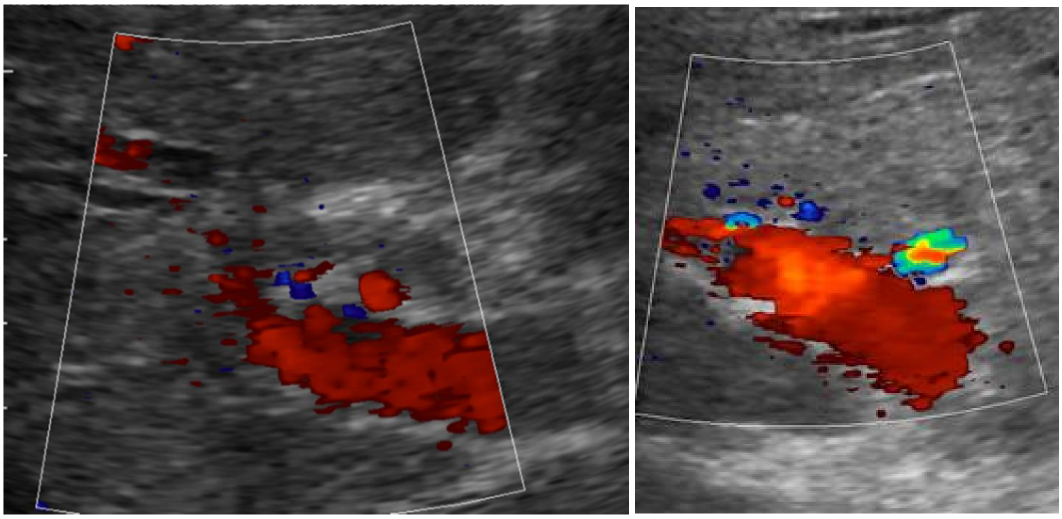


Fig. 4.4.35 a, b Tumour ("Klatskin´s" tumour, CCC in portal position) in hepatic bile duct and interjacent right branch of hepatic artery with double-barrelled shotgun phenomenon; FS right with CCDS

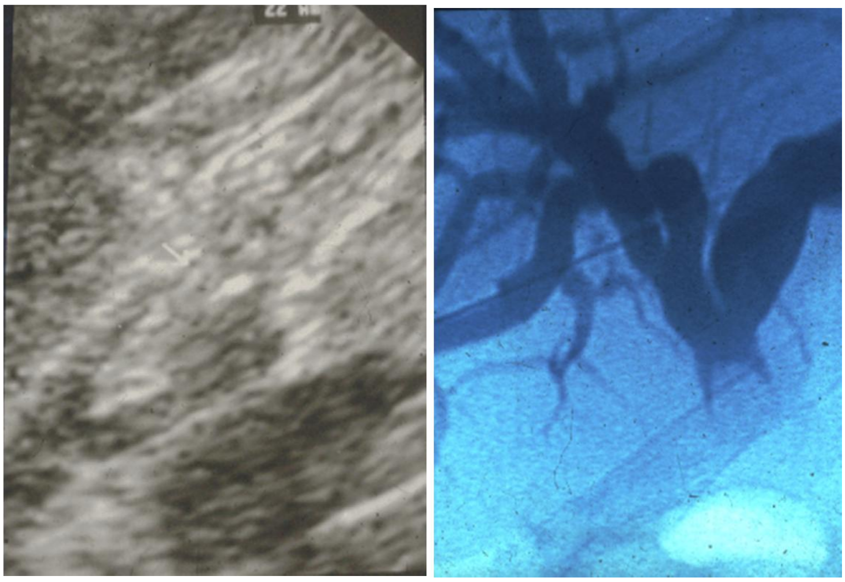


Fig. 4.4.36 a, b Lithogenic occlusion, FS right (a), PTC-C picture (b)

Fig. 4.4.37 Small amount of gas in partially relieved cystic and hepatic bile ducts after EPT; FS right

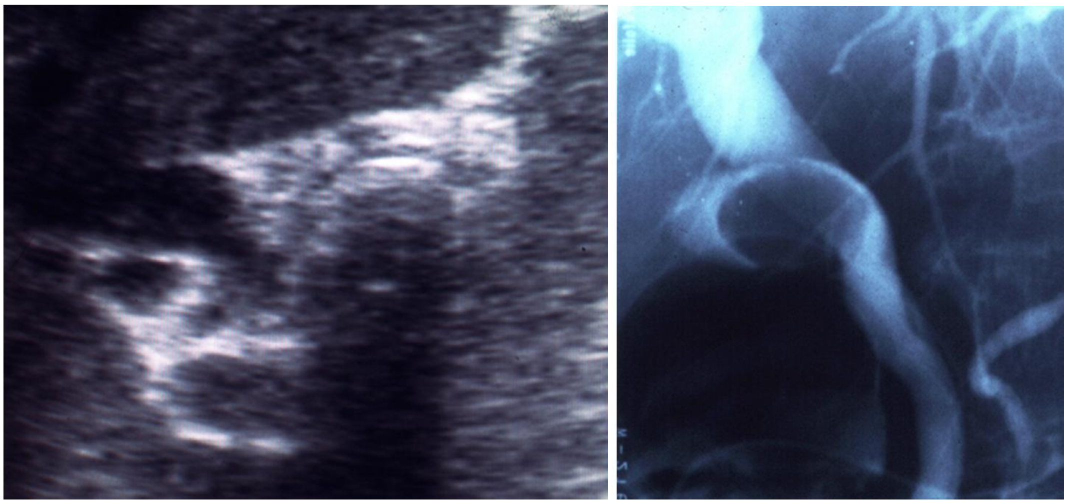


Fig. 4.4.38 a, b Mirizzi's syndrome sonographically and by ERCP (two different cases); FS right (a, b), and ERCP (b)

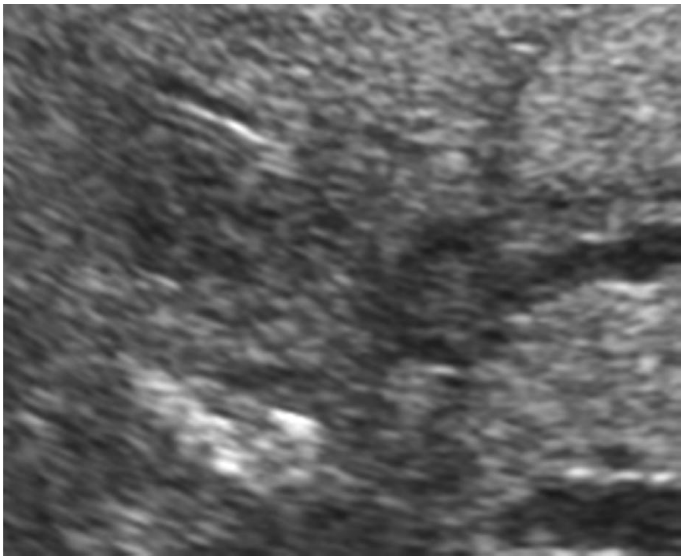


Fig. 4.4.39 FL (clinically ultimately corresponding to a CCC) in the liver with local biliary obstruction; UAS transverse

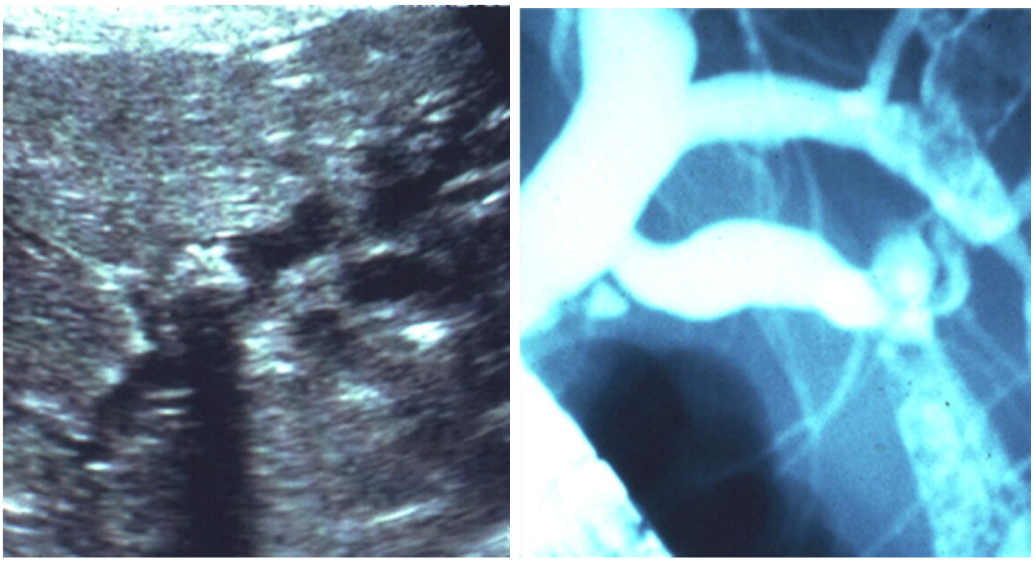


Fig. 4.4.40 a, b Cholangiolithiasis; UAs transverse (a) and ERCP (b)

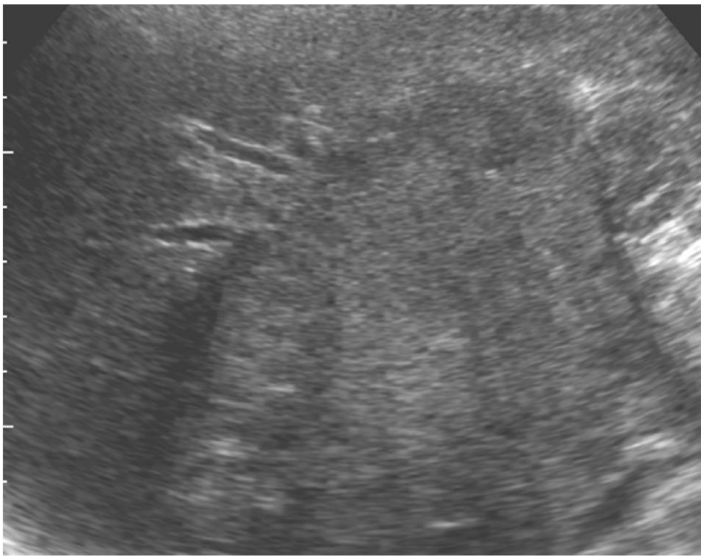


Fig. 4.4.41 Large portal CCC ("Klatskin´s" tumour) with local bile duct outflow obstruction; FS right

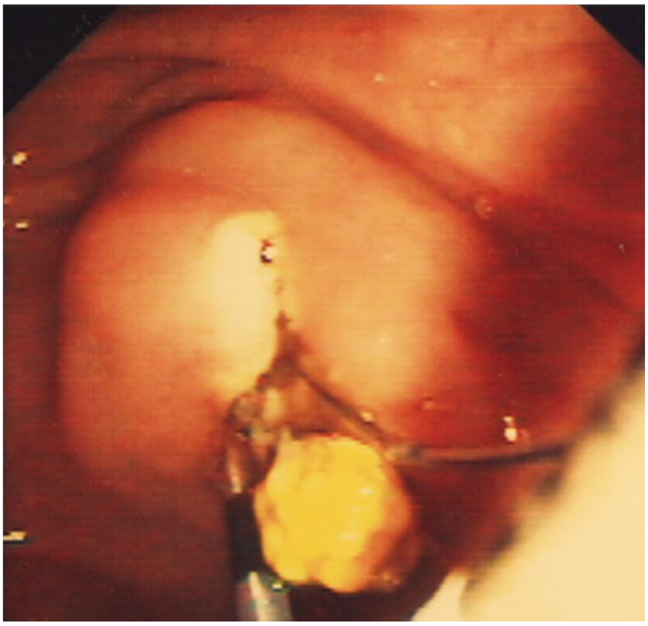


Fig. 4.4.42 EPT with extrication of a small bile duct calculi after EPT, endoscopic aspect

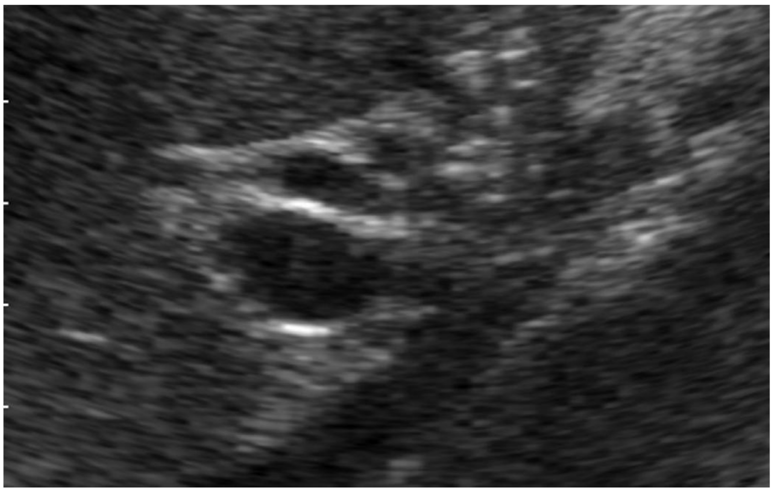


Fig. 4.4.43 Ultimately malign occlusion of hepatic porta, variant pathway of hepatic artery (ventrally of hepatic bile duct); FS right

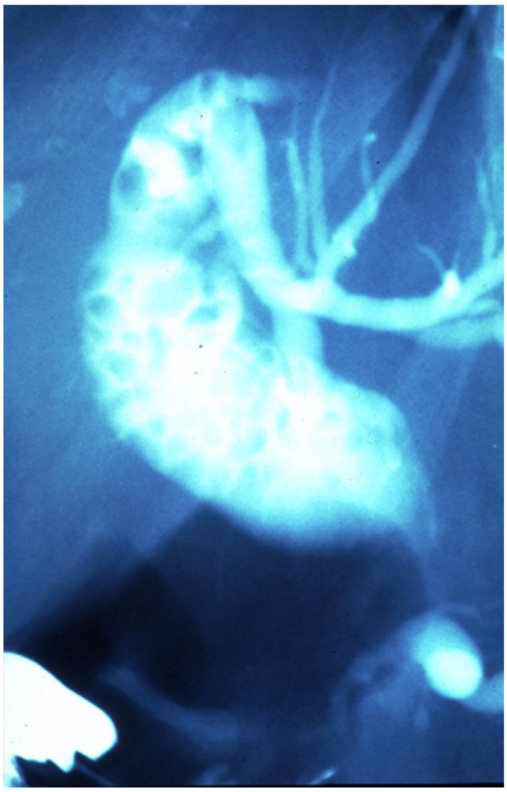


Fig. 4.4.44 Completely calculus filled almost fluid-free hepatic bile duct in ERCP

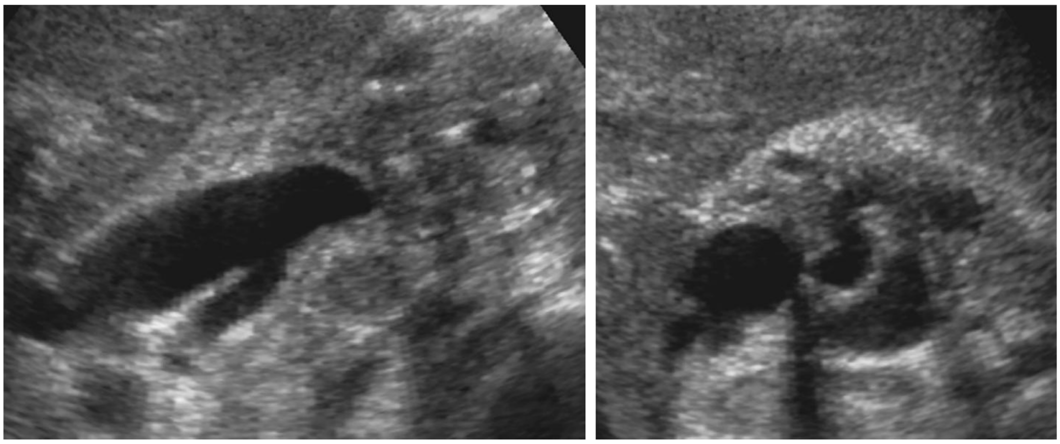


Fig. 4.4.45 a, b Biliodigestive anastomosis (a), discreet but unequivocally congested (dilated) cystic duct trunk, moderate lymphadenopathy, normal portal vein and hepatic artery, above (b) slightly expanded pancreatic duct and markedly dilated hepatic bile duct with papillary tumour; FS right (two different cases)

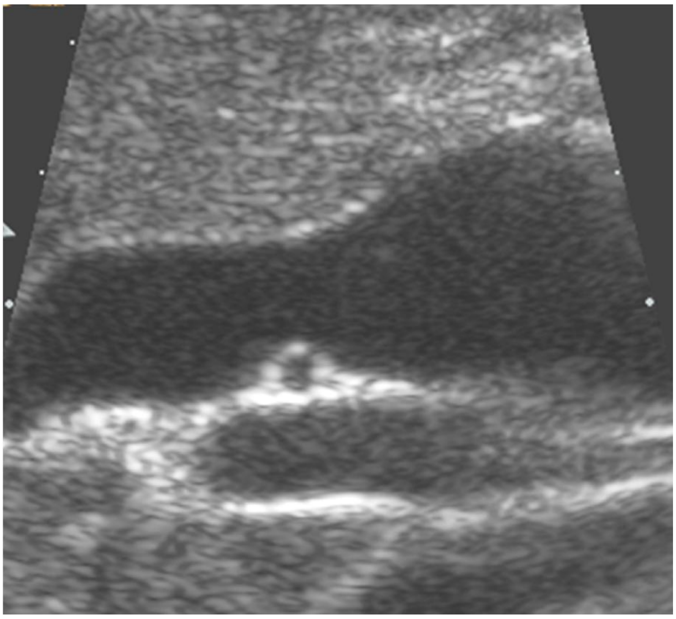


Fig. 4.4.46 Congested (dilated) hepatic bile duct, normal portal vein, and typical interjacent branch of hepatic artery, as well was truncated liver sections and portal vein; FS right

Bile duct anomalies are very rare in adult medicine (in contrast to paediatrics).

The highly complicated congenital bile duct atresia necessitates paediatric competence. With a frequency of 1:20,000 the clinical picture is divided into complete and incomplete anomalies of the intra and extrahepatic bile ducts.

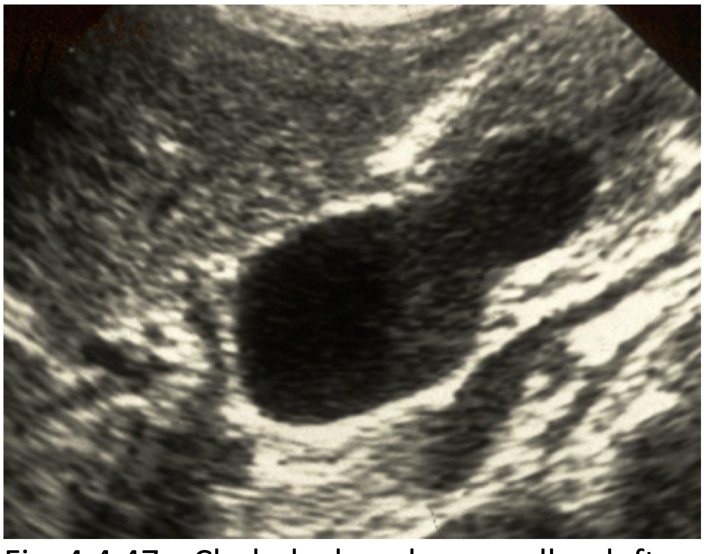


Fig. 4.4.47 Choledochocele, as well as left renal artery between diaphragm and inferior vena cava - a normal finding in optimally examined young girls; FS right

The bile duct cyst/ cholangiocele/congenital bile duct expansion are without reliable numbers on frequency (about 1:100,000); women are seemingly affected more often than men; patients can remain without symptoms until adulthood.

A definitive diagnosis by ultrasound is difficult, a more precise relationship to the bile duct system is to be aimed at using MRCP, possibly ERCP is necessary.

The (very rare) additional proof of adenomas in hepatic cysts is principally possible; the differentiation of concrements can be difficult. Because of an existing malign degeneration risk, surgical treatment is always indicated.

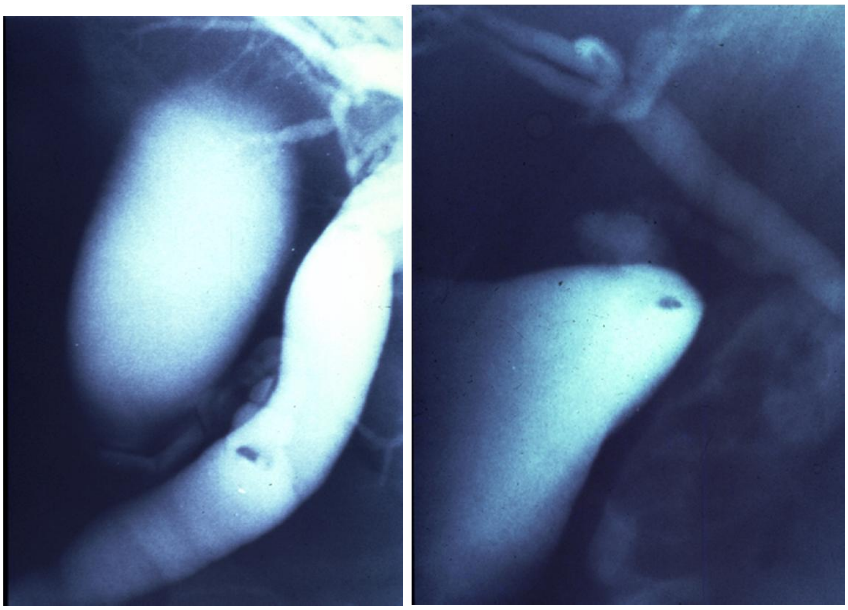


Fig. 4.4.48 a, b False diagnosis of choledocholithiasis by prominent invagination of cystic duct inlet (a) or outlet (b) D (two cases)

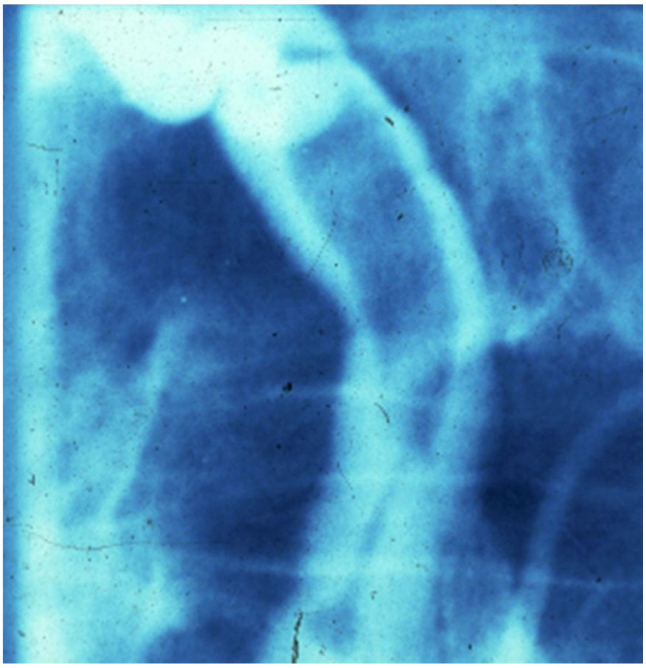


Fig. 4.4.49 Chinese liver fluke in the hepatic bile duct; ERCP

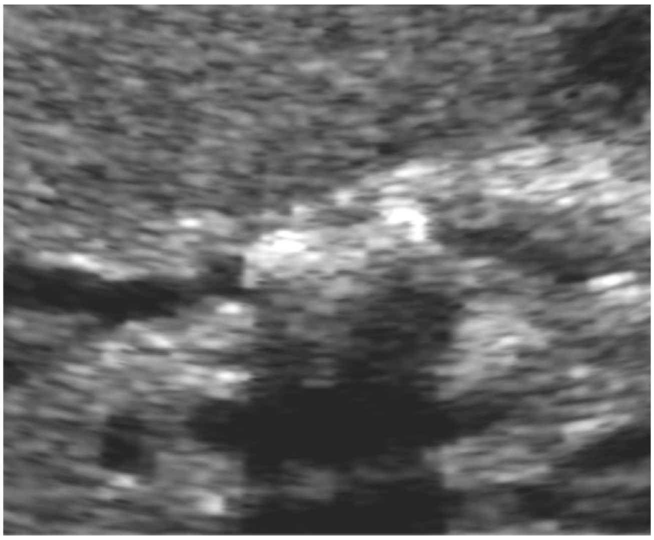


Fig. 4.4.50 Choledocholithiasis with minimal but significant biliary congestion; FS right

Fig. 4.4.51 a, b Gallstone obstruction; LAS transverse

The Caroli syndrome is rare and makes up about 1% of cystic bile duct changes. There are intrahepatic, multiple, partially stringed cystic or saccular bile duct expansions of different sizes. Concomitantly existing is a portal fibrosis. Concrements, icterus and chronic cholangitis, liver abscesses, and also bouts of pancreatitis undergo complicated developments. Also for these cases malign degenerations can be possible.

Caroli disease - to be distinguished subtly from the Caroli syndrome (which is only sometimes possible) - is congenital and even rarer, and affects predominantly women. Also here are segmental dilations of the bile ducts; in contrast to the Caroli syndrome cysts and portal fibrosis are lacking.

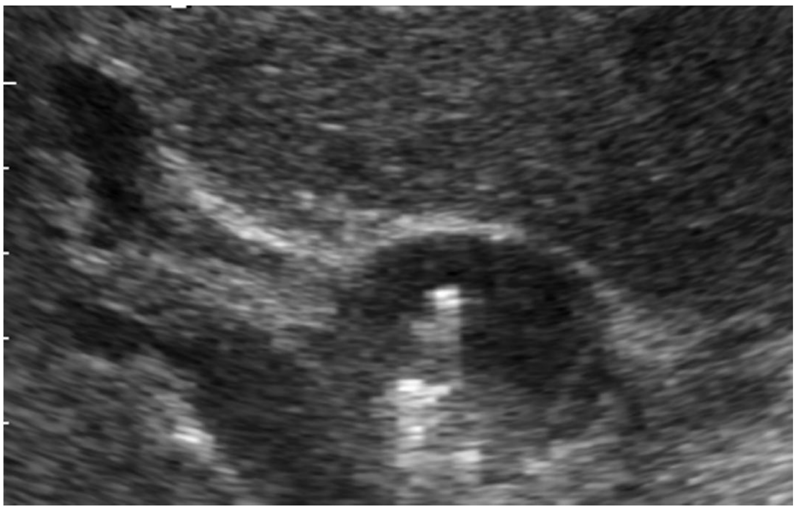


Fig. 4.4.52 Clips in hepatic artery aneurysm; FS right

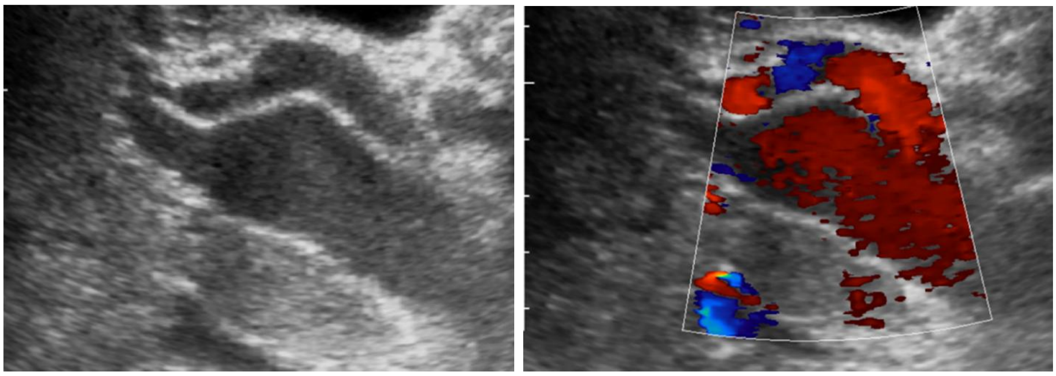


Fig. 4.4.53 a, b Not the hepatic bile duct, but the markedly strongly pulsating branch of the hepatic artery; FS right (clinical Osler's disease of the liver with a cirrhosis-like appearance); FS right (b with CCDS)

CCC, which belongs to the rare cancer types, can be situated intra or extrahepatically; located at the bile duct bifurcation they are called Klatskin tumour. Particularly difficult to visualize can be the strict peripheral position, as well as diffuse growth along the bile ducts, without recognizable biliary congestion. Growth of metastases in bile ducts is extraordinarily rare; proliferation is likely to be inside the wall.

In circumscribed dilated intrahepatic bile ducts, CCC should always be looked for.

While colour Doppler sonography does not provide diagnostic support (apart from secondary findings such as vascular dislocation and compression, portal thrombosis, and respective collateral display), normal ultrasound is of considerable diagnostic value.

CCC is often poorly distinguishable by basic ultrasound, and can be much better assessed in its overall size by CM imaging. The arterial phase shows a differently pronounced, mostly chaotic vascularization. In the portal and late phase CCC does not stand out by contrast from the surrounding liver. Additionally, proof of hepatic metastases is sometimes considerably improved.

Fig. 4.4.54 Choledocholithiasis with biliary congestion; FS right

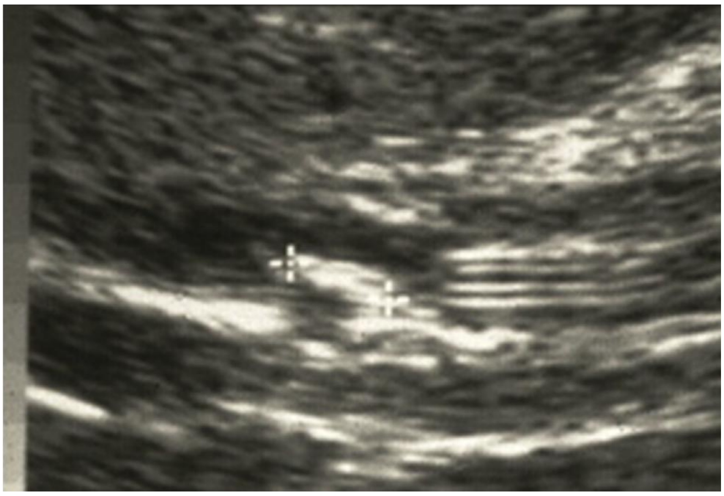


Fig. 4.4.55 Residual gallstone (measuring crosses) in the slightly dilated hepatic bile duct in front of the well detectable T-shaped drainage shaft; FS right

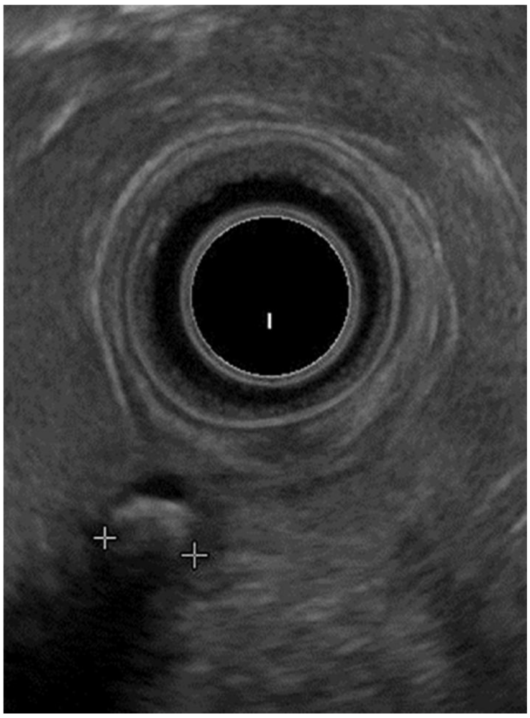


Fig. 4.4.56   Choledocholithiasis in EUS

Reliable differentiation of CCC from HCC is not possible, but the former is significantly less frequent than HCC. Large/larger solitary solid space occupation of liver and small hepatic metastases indicate CCC; solitary liver space occupation and lymph node metastases of the liver porta speak rather against a HCC and for a CCC or extrahepatic primary tumour. Solitary liver space occupation, as well as satellite metastases, matches HCC as also a tumour thrombus in the portal vein.

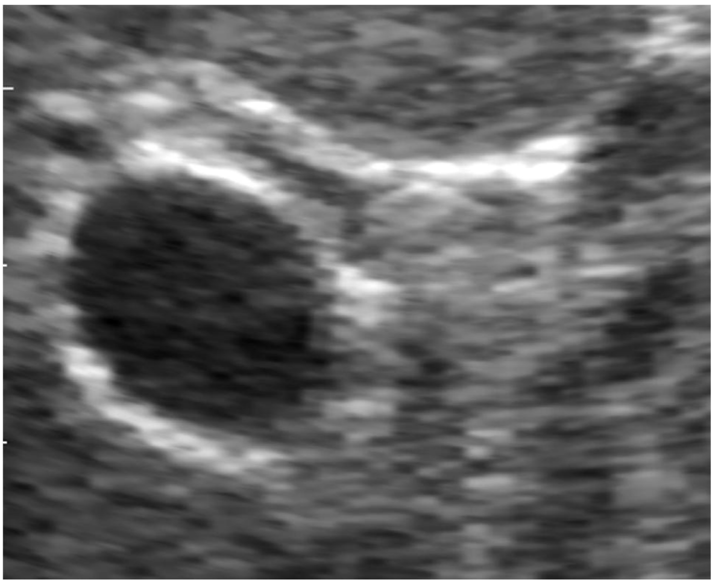


Fig. 4.4.57   Asymptomatic choledocholithiasis, hard to see with little fluid, as well as a discrepancy between calculus size on one hand and normal diameter of the

hepatic bile duct on the other; interjacent hepatic artery branch (helpful for anatomic orientation); FS right

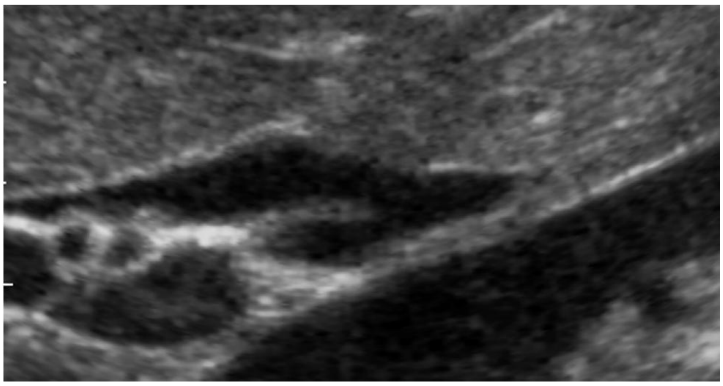


Fig. 4.4.58 Discreet but clearly slightly congested cystic trunk, variation of interjacent right branch of hepatic artery (doubled), portal vein and vena cava, as well as normal right renal artery, clinical choledocholithiasis; FS right

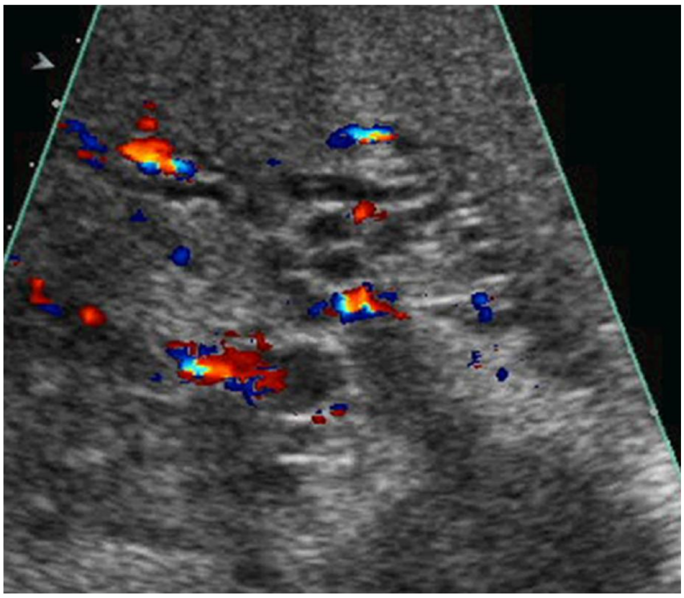


Fig. 4.4.59 Malignoma typical occlusion of liver porta; clinical CCC; FS right with CCDS

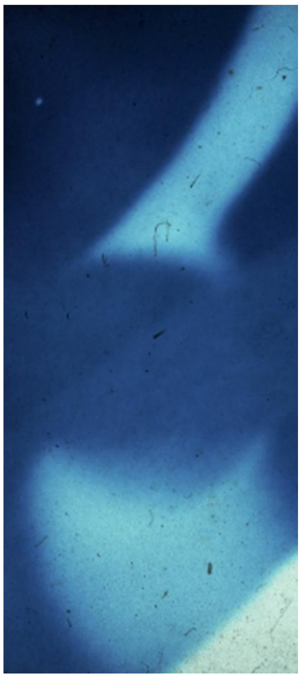


Fig. 4.4.60 After all benign lithogenic occlusion with sufficient injection pressure in ERCP

Fig. 4.4.61 Biliodynamic active hepatic bile duct stenosis, sonographically only to be suspected; ERCP

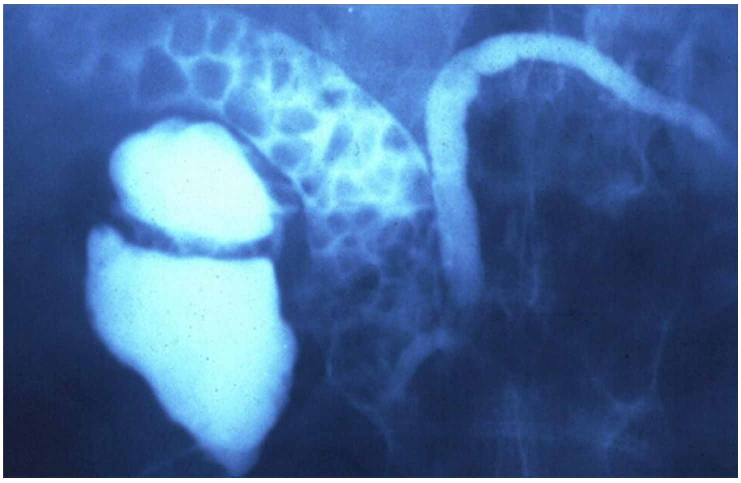


Fig. 4.4.62 Sonographically overlooked calculus-filled hepatic bile duct; ERCP

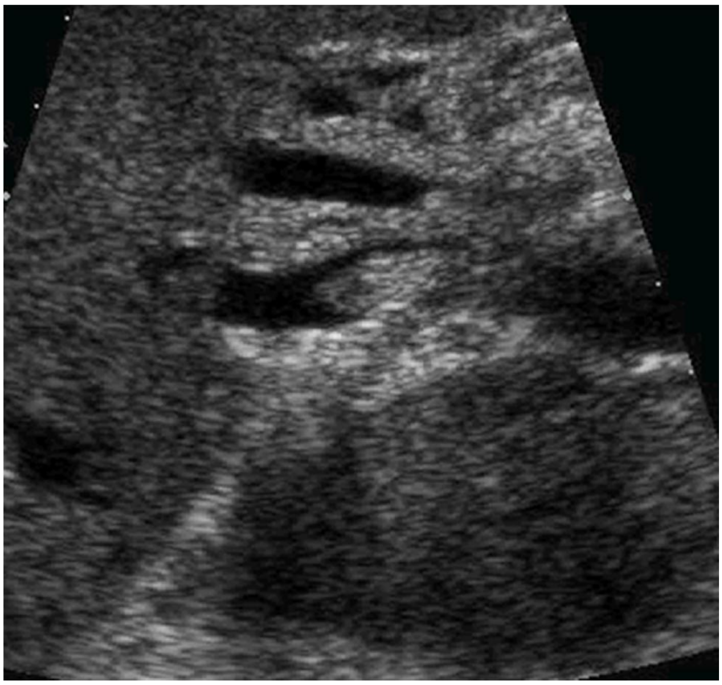


Fig. 4.4.63 Malignoma typical occlusion of liver porta (clinical CCC); FS right

Papillary tumours are always accompanied by a dilatation of the preceding bile ducts. Papillary tumours are dependent on their size, examination conditions, and the skill of the sonographer, potentially also directly or rather indirectly depictable by upper abdominal sonography. Small tumours often evade detection. The diagnostic method of choice in this case is EUS.

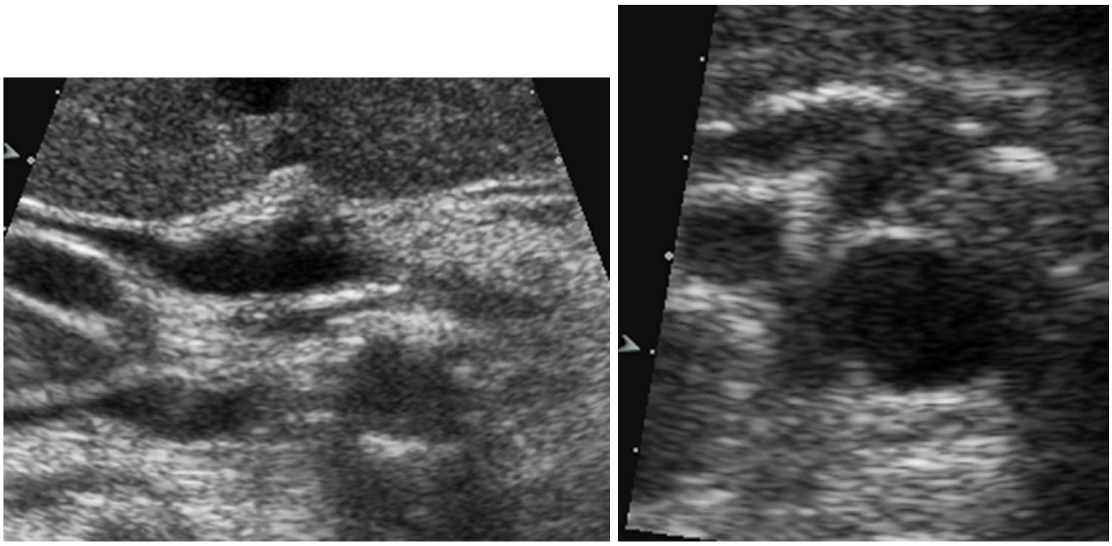


Fig. 4.4.64 a, b Aerobilia after EPT also in the cystic trunk (a), and in another case in the hepatic bile duct (b); FS right

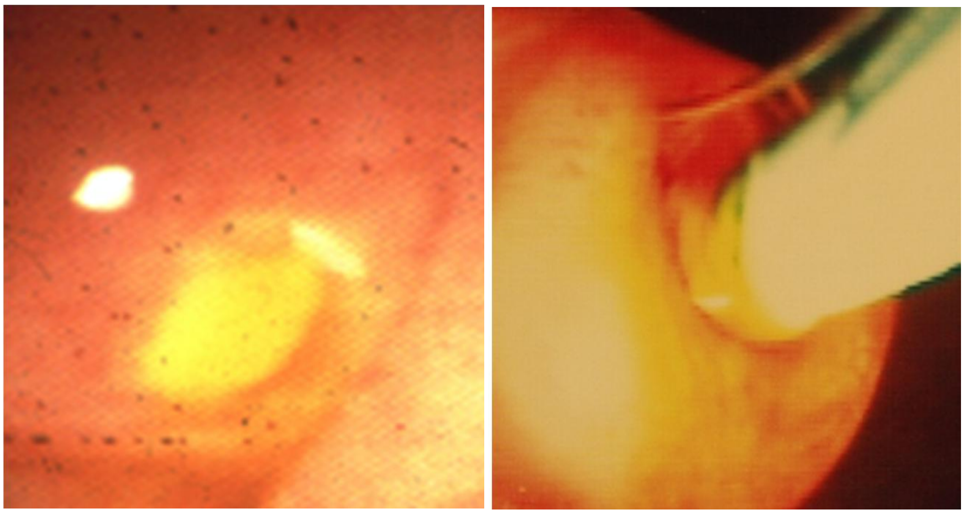


Fig. 4.4.65 a, b Intra-papillary gallstone (a), and, in another case, EPT

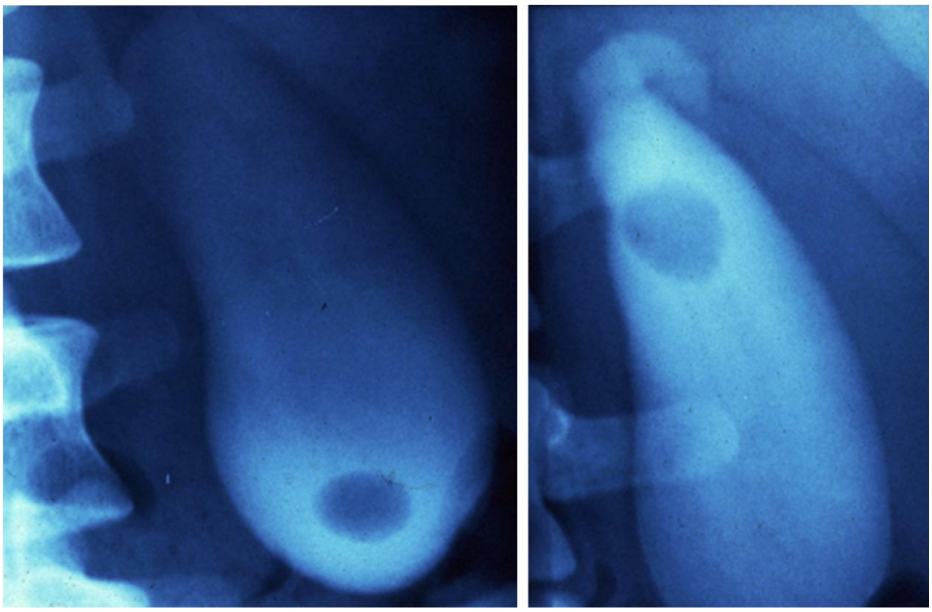


Fig. 4.4.66 a, b Feigned additional calculus by transverse process of the rib (b); ERCP

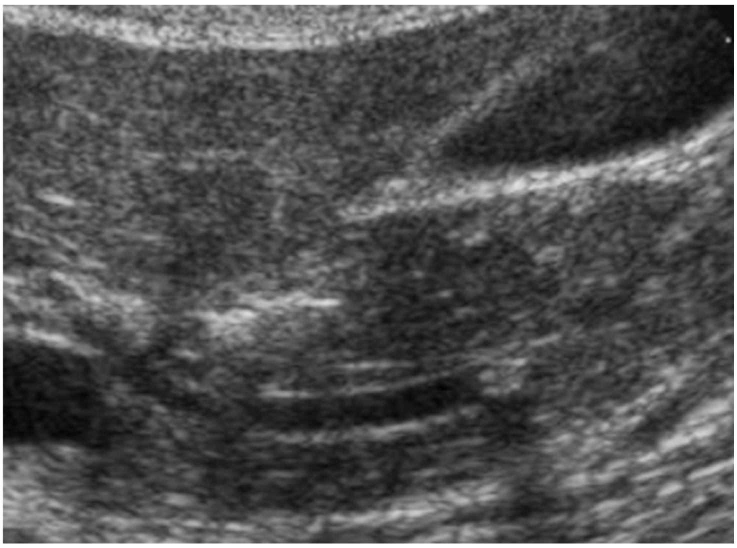


Fig. 4.4.67 Symptomatic prepapillary choledocholithiasis, discreetly dilated (congested) hepatic bile duct, normal portal vein as well as pancreas and truncated gallbladder and liver; FS right

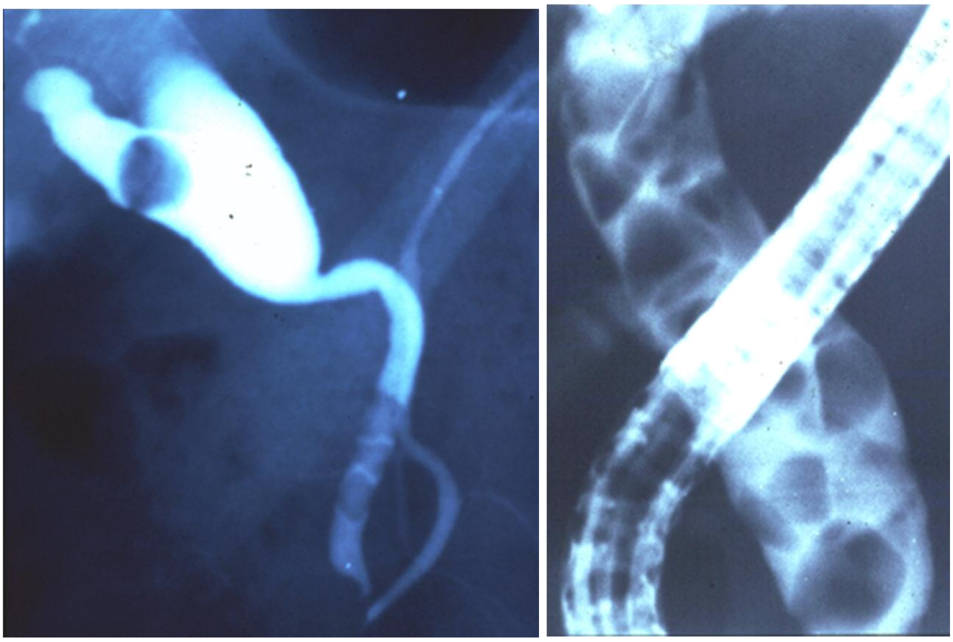


Fig. 4.4.68 a, b	Probably asymptomatic larger as well as several symptomatic small gallstones (a), which initially evaded direct sonographic detection because of lacking dilatation and minimal fluid flow, also bile duct stones (b); ERCP (two cases)

Fig. 4.4.69 a, b	Gallstone fragments filtered from faeces after ESWL on mm grid

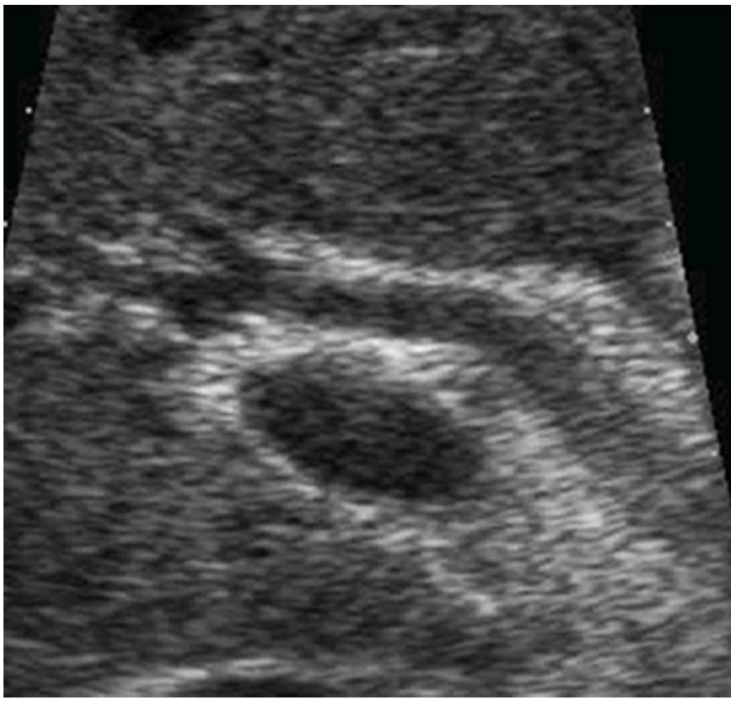


Fig. 4.4.70 Dilated hepatic bile duct filled with sludge and microcalculi; FS right

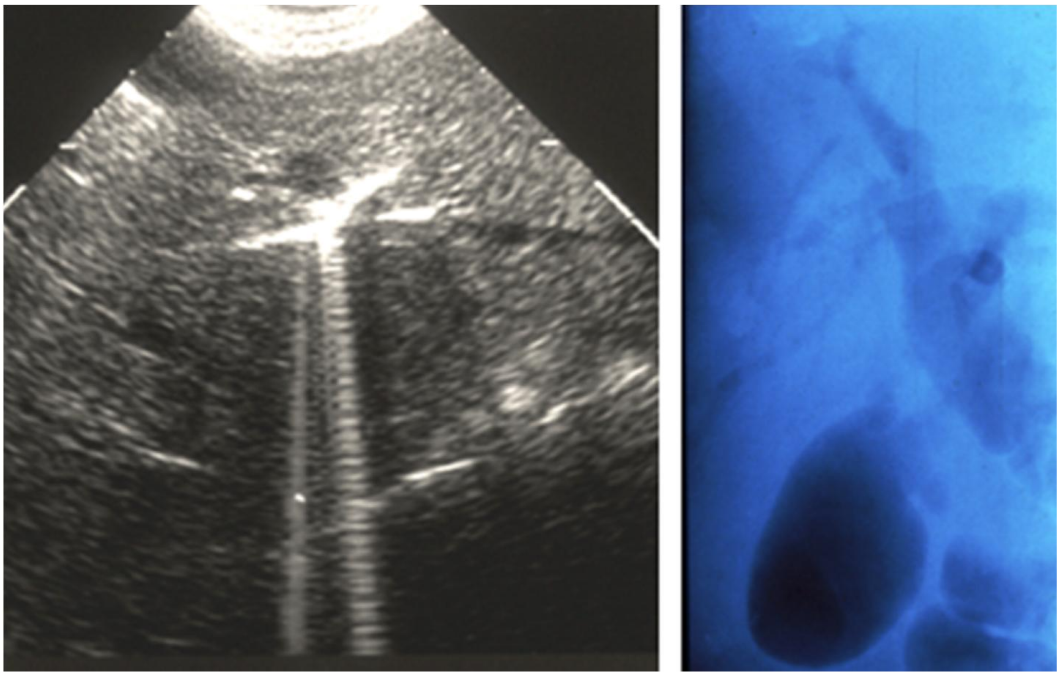


Fig. 4.4.71 a, b Aerobilia and aerocystia in high-impedance echo typical for gases, as well as reverberations between bile duct walls and the gas, aerocystia after extensive EPT; SCS right (a); note the differences in the pictures, which are triggered by the gas in x-ray and ultrasound technique.

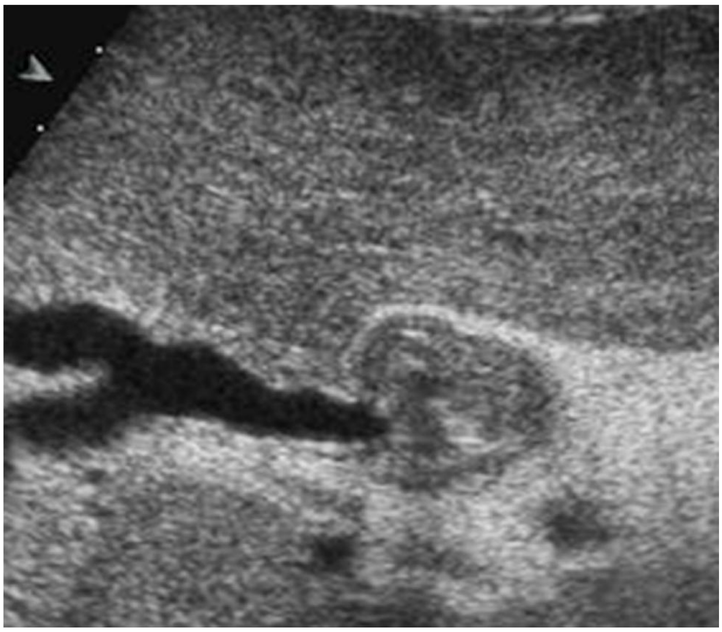


Fig. 4.4.72 Biliodigestive anastomosis with discreet bile congestion and lacking aerobilia; FS right

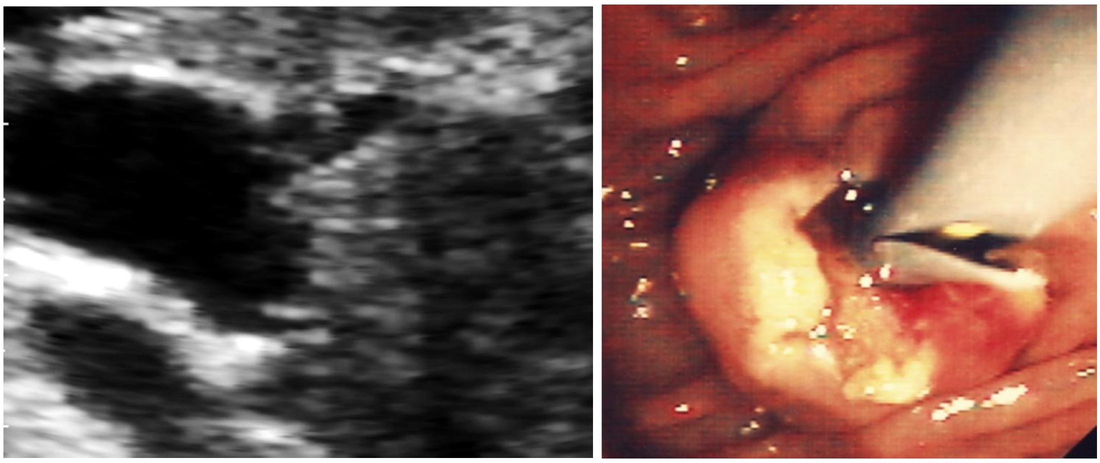


Fig 4.4.73 a, b Malignoma typical occlusion (cholangiocarcinoma) of the congested hepatic bile duct (a,) normal hepatic artery branch and splenic vein; FS right (a), (b after EPT and stent).

However, it is practicable for the physician and the affected (and his/her relatives!) to already know about an evidencing sonographically proven choledocholithiasis prior to the necessary EPT.

It is also true for extrahepatic bile ducts that they are (nearly) free of smooth muscle fibres, and react even with only minimal intraductal pressure elevation with immediate dilatation.

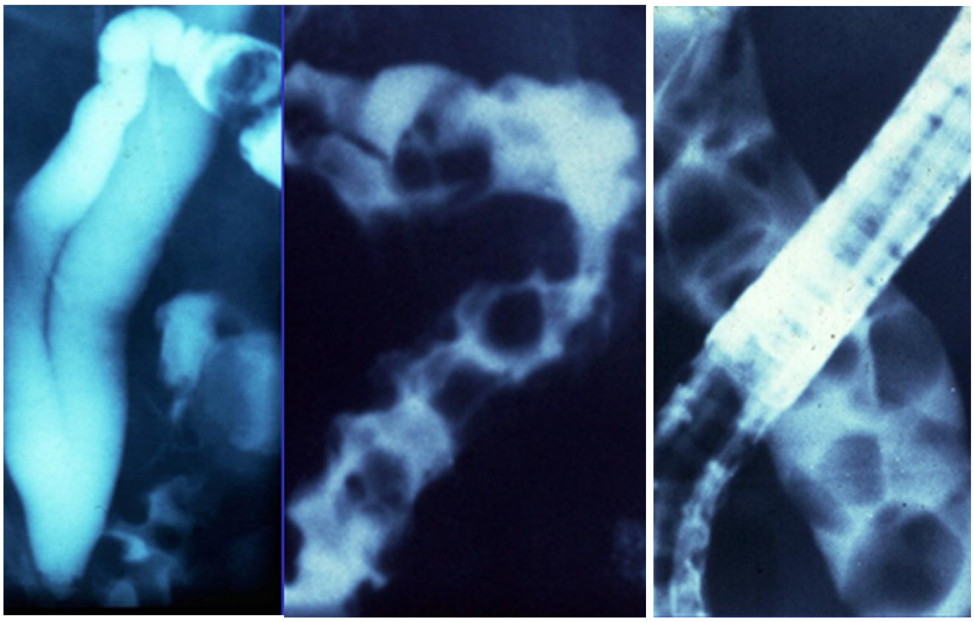


Fig. 4.4.74 a-c Sonographically hardly verifiable choledocholithiasis (hidden a, with only little liquid b and c); ERCP (different cases)

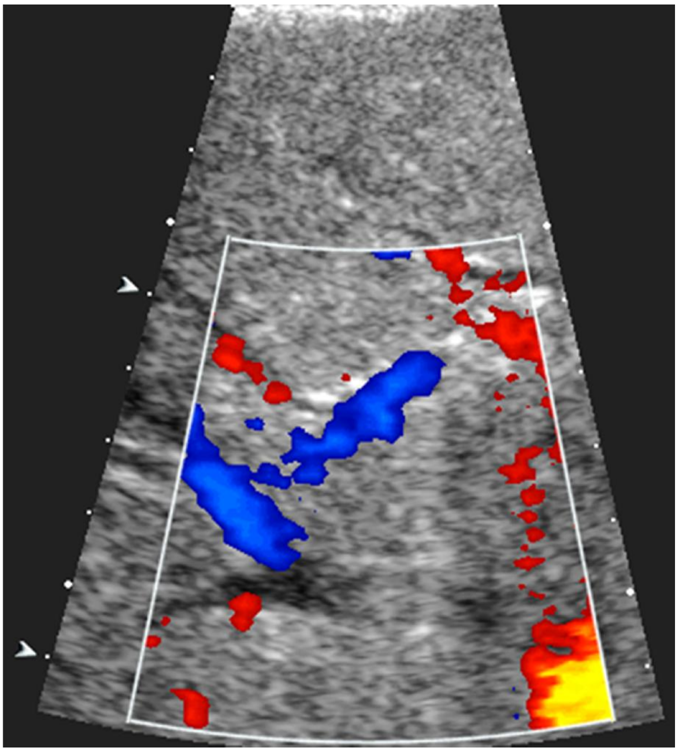


Fig. 4.4.75 Suspected isoechogenic HCC with vessel invasion; UAS transverse

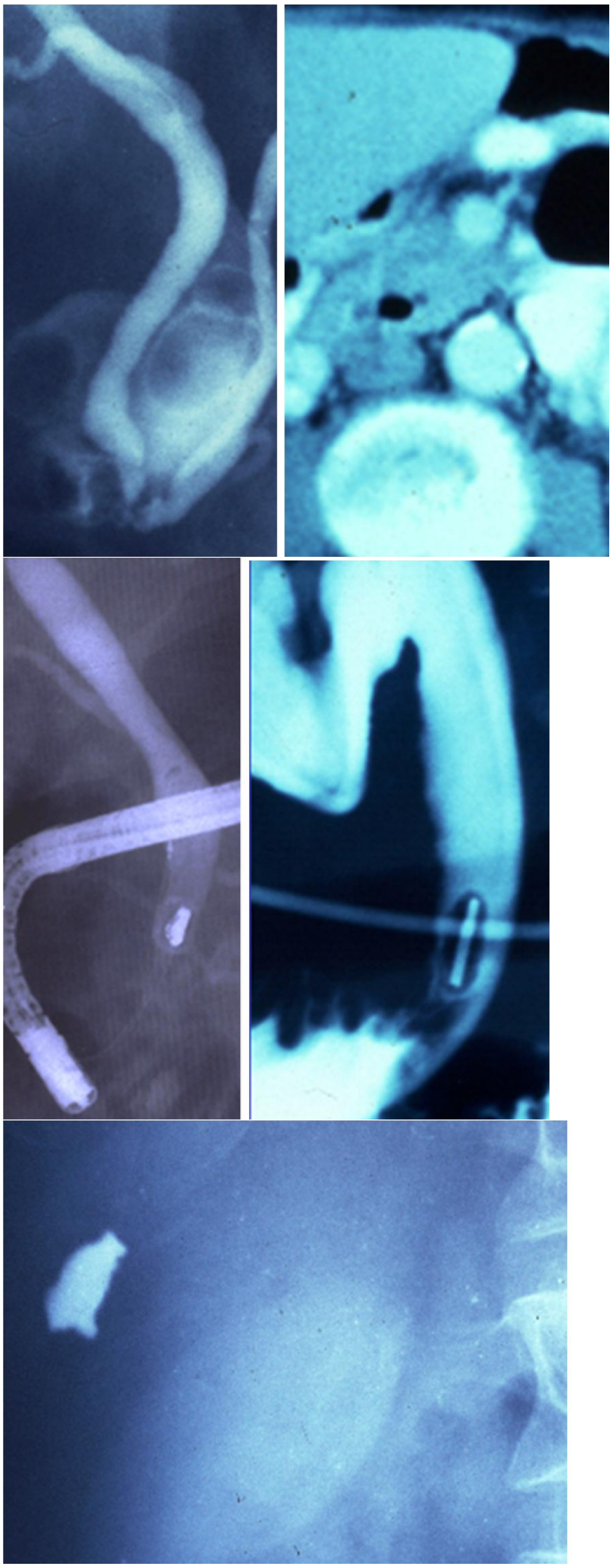


Fig. 4.4.76 a-e Juxtapapillary duodenal diverticulum (filled with food remnants) with faint (sonographically hardly visible) hepatic bile duct (a, b), as well as three additional cases of a migrating clip (c, d), as well as a stuck projectile in liver (e), not the usual gallstones; ERCP (a, c, d), and CT (b), or blank

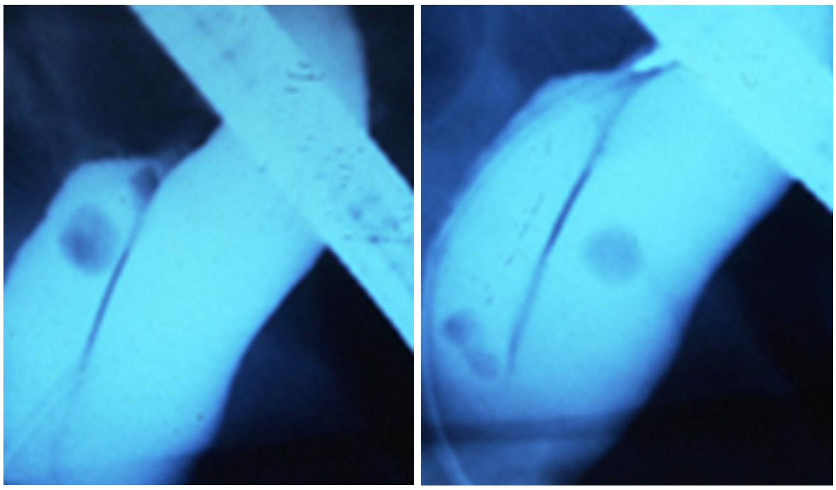


Fig. 4.4.77 a, b Variable position of choledocholithiasis; ERCP

Fig 4.4.78 Pronounced aerobilia of hepatic bile duct after EPT; FS right

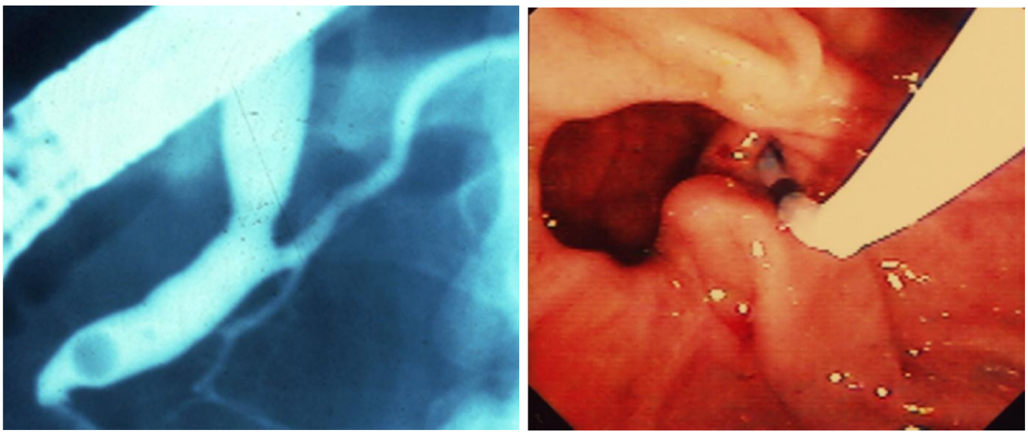


Fig. 4.4.79 a, b Choledocholithiasis and long common channel of hepatic bile duct and pancreas; ERCP, complicated EPT with juxtapapillary duodenal diverticulum (different cases)

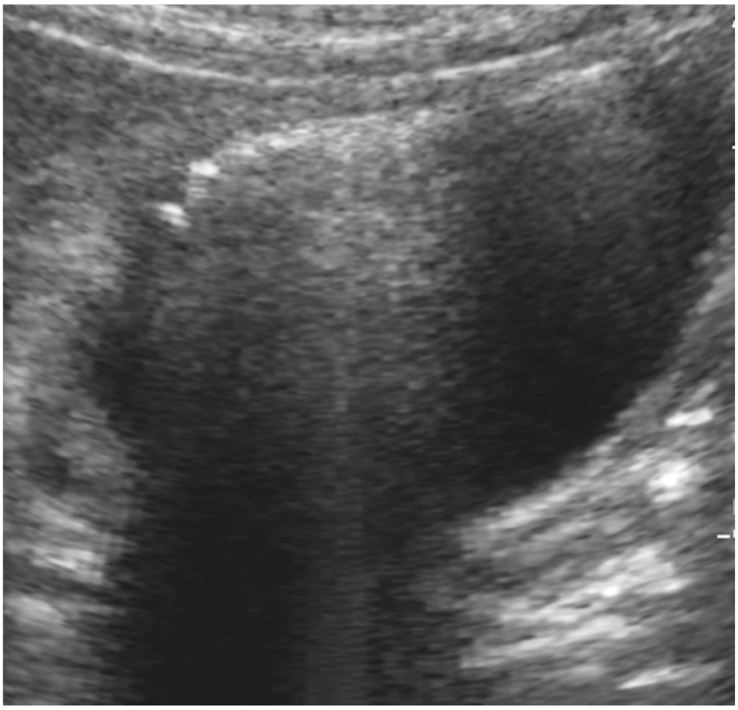


Fig. 4.4.80 Aerocystia after EPT in the sonogram; UAS longitudinal

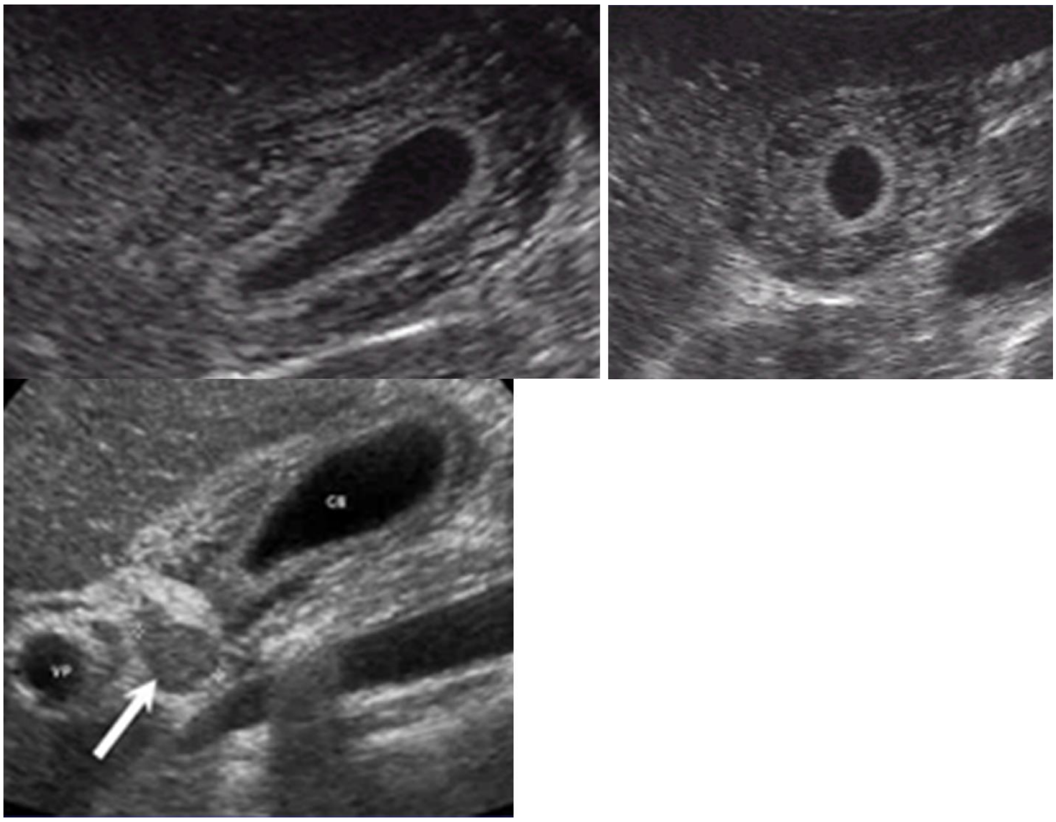


Fig. 4.4.81 a-c Difficult funnel shaped cholecystolithiasis (arrow), chronic-inflammatory wall thickening; SCS right and UAS longitudinal (b)

Fig. 4.4.82 Acute (lithogenic) cholecystitis with covered gallbladder perforation; SCS right

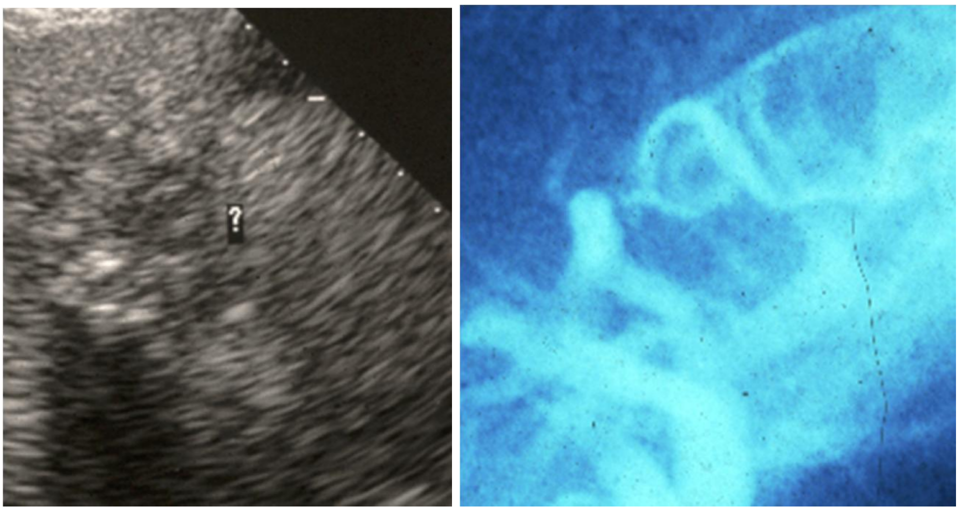


Fig. 4.4.83 a, b Unusually deep seated intrahepatic sclero-atrophic contracted gallbladder; SCS right (a), ERCP (b)

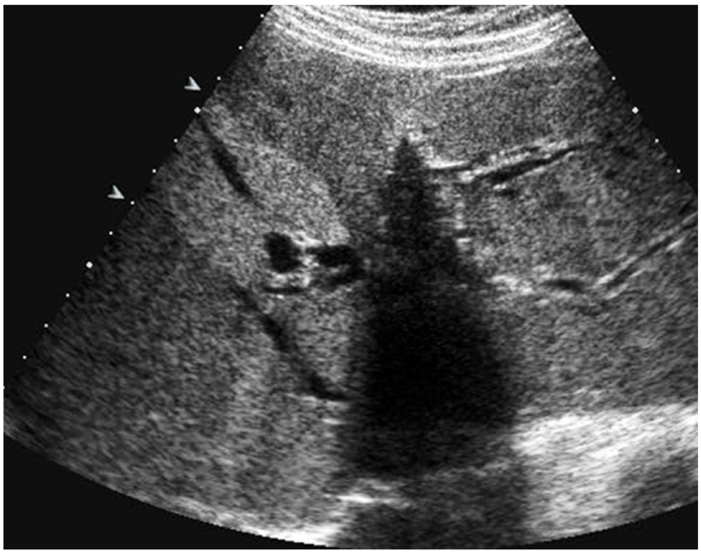


Fig. 4.4.84 Unilateral biliary occlusion and falciform ligament, double-barrelled shotgun phenomenon; SCS right

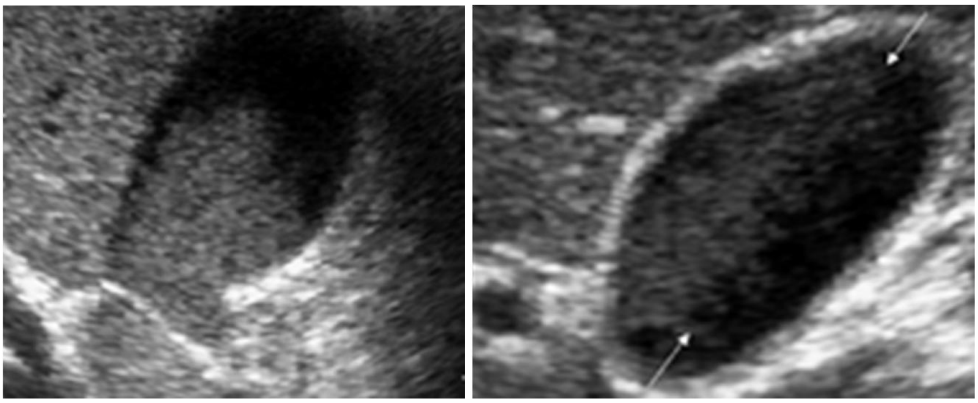


Fig. 4.4.85 a, b Location variable sludge (floating in left lateral position; arrows in b); FS right

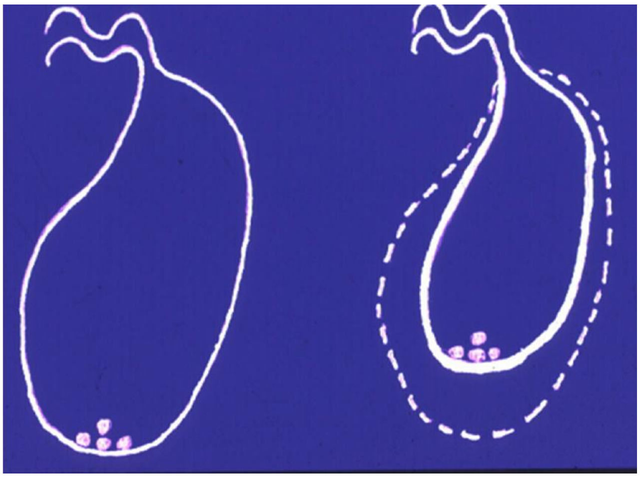


Fig. 4.4.86 Gallbladder contraction and constant position of gravitation-dependent cholecystolithiasis (schematic representation)

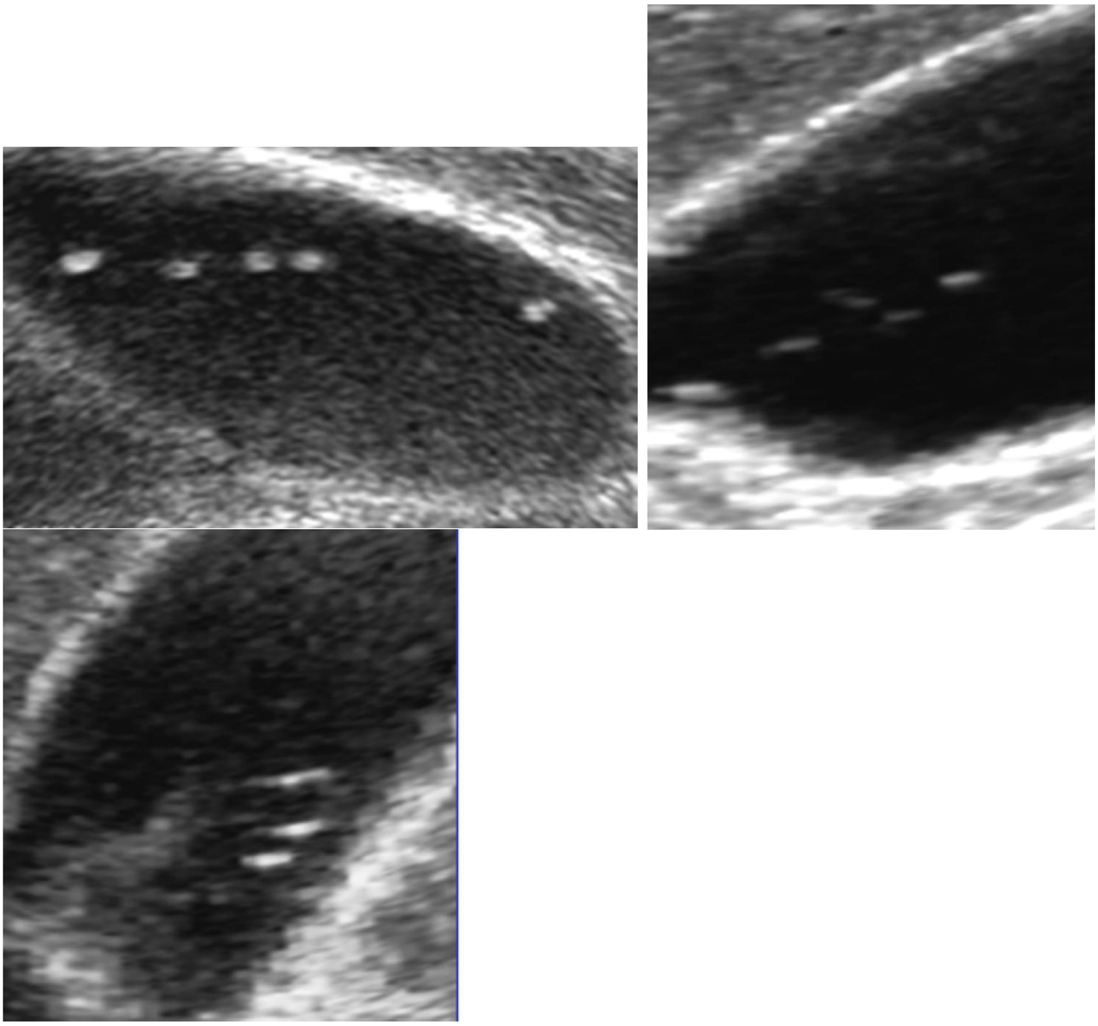


Fig. 4.4.87 a-c After partial filling of the gallbladder using ERCP better visibility of small gallbladder stones swimming in borderline layer (suspected before based on history); SCS right

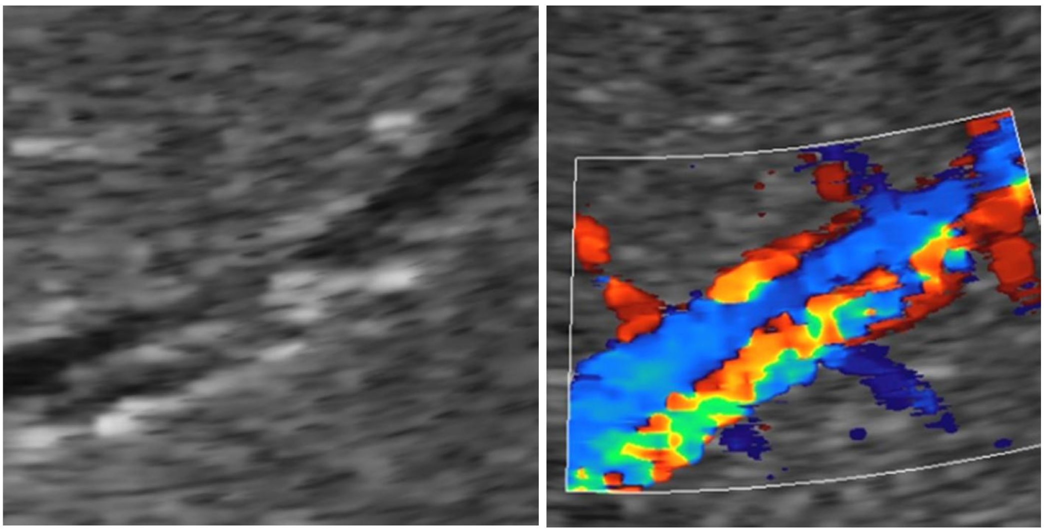


Fig. 4.4.88 a, b Intrahepatic very strong artery branch (clinical hepatic participation in Osler's disease), no intrahepatic bile duct dilatation; SCS (b with CCDS)

Fig. 4.4.89 Inter-dependencies between the examined, examiner and device, sonographic assistant in the background

Fig. 4.4.90 Tumour thrombosis of portal vein with undefinable HCC; FS right

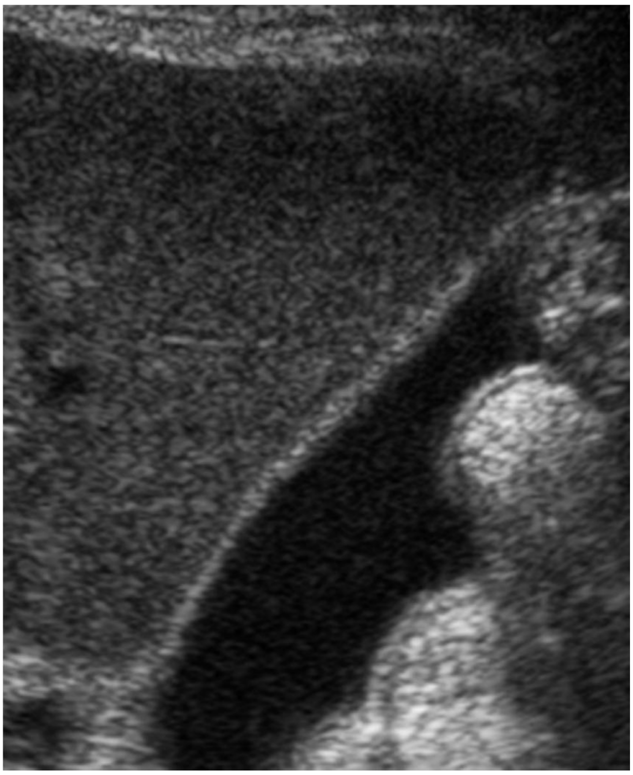
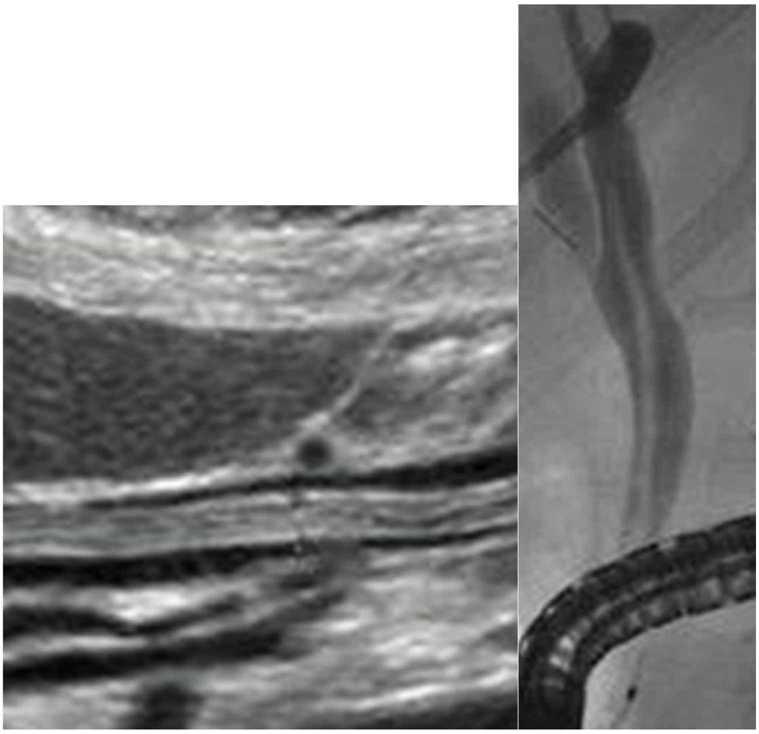


Fig. 4.4.91 Intestinal gas abundant right flexure, simulating cholecystolithiasis; FS right



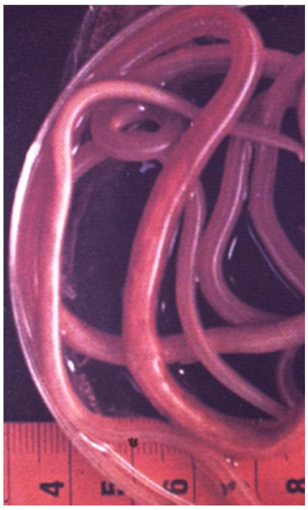


Fig. 4.4.92 a-c Giant roundworm (Ascaris lumbricoides); FS (different cases); FS right (a, c), and ERCP (b)

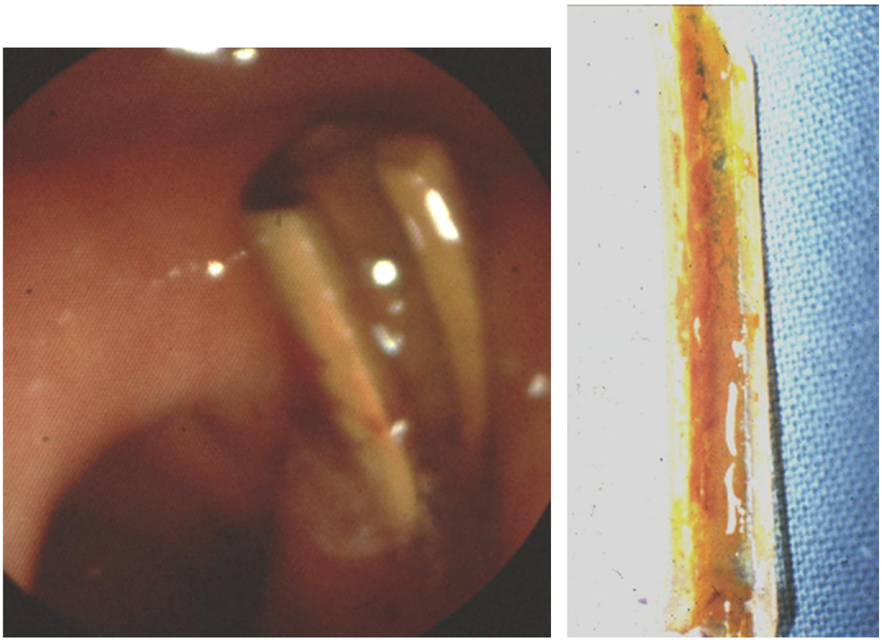


Fig. 4.4.93 a, b Torn T-shaped drainage shaft, bile duct dilatation (a endoscopic view, b after EPT and extraction)

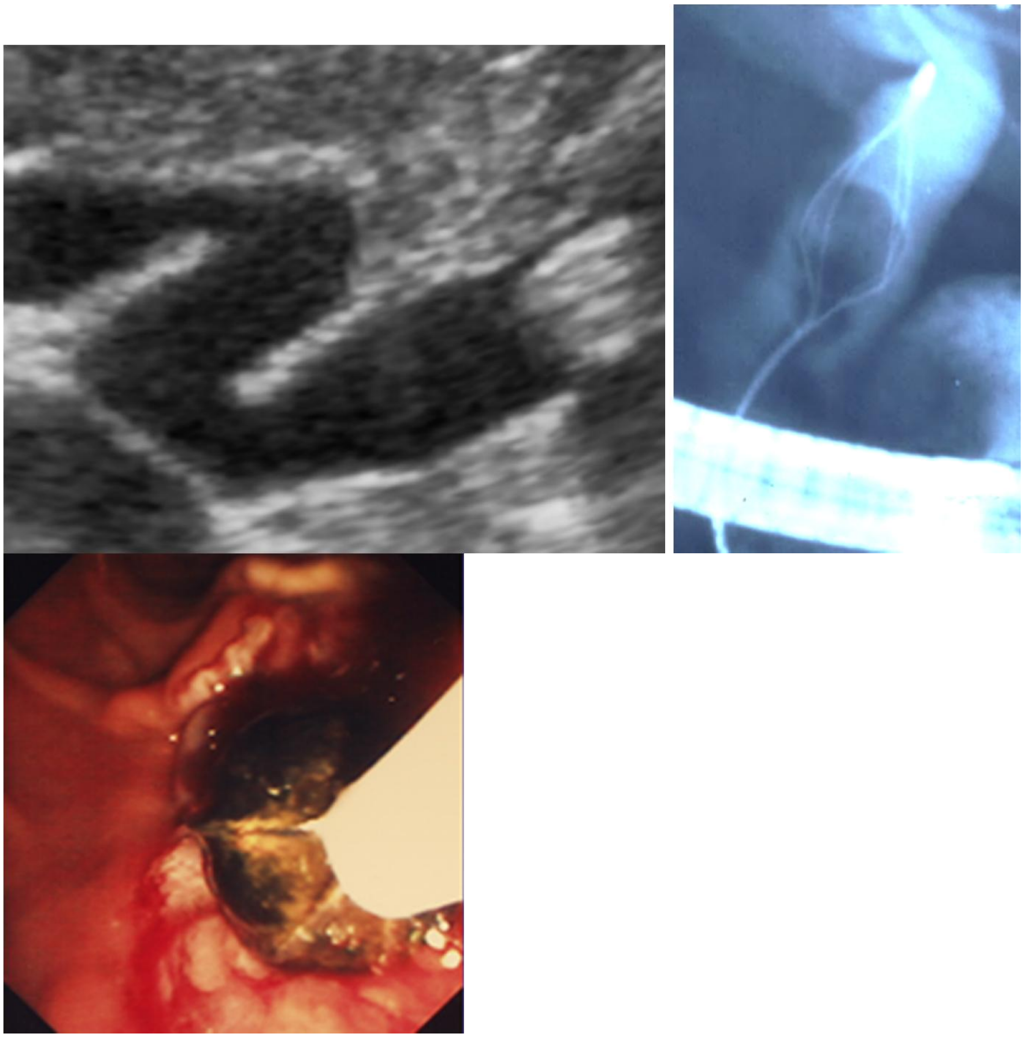


Fig. 4.4.94 a-c EPT after prepapillary proof of choledocholithiasis, kinking of hepatic bile duct after several weeks of congestion (a); FS right

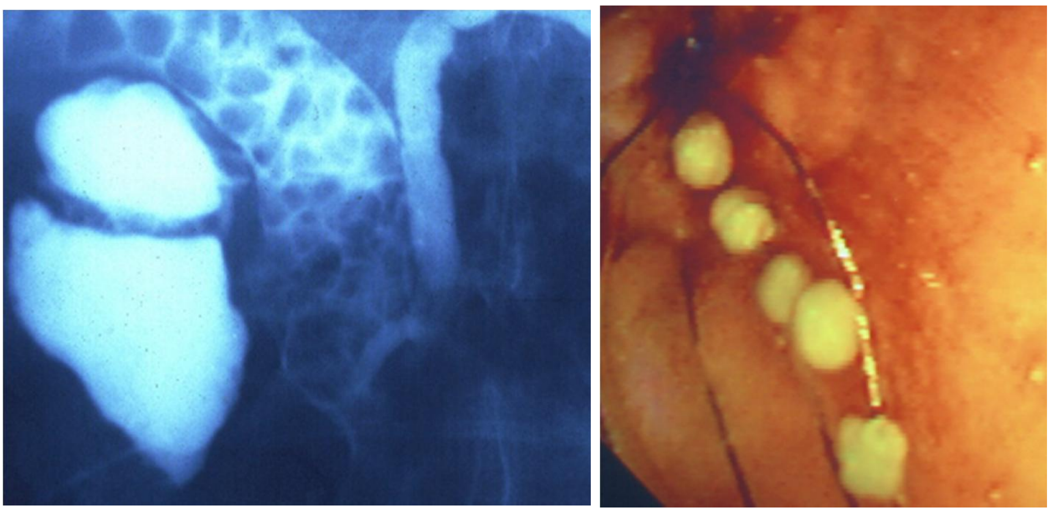


Fig. 4.4.95 a, b Choledocholithiasis sonographically by mistake interpreted as cholecystolithiasis; ERCP (and subsequent EPT, endoscopic aspect)

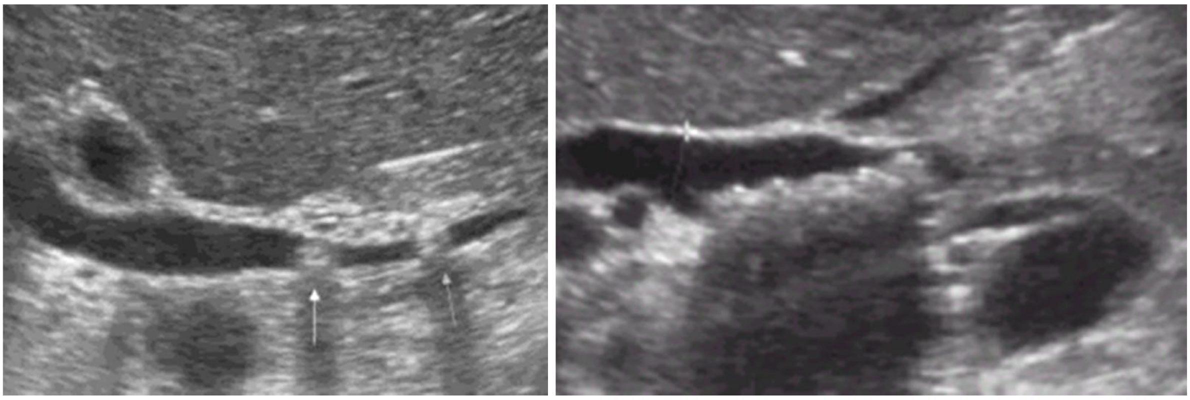


Fig. 4.4.96 a, b Two different cases of choledocholithiasis (arrows); FS right

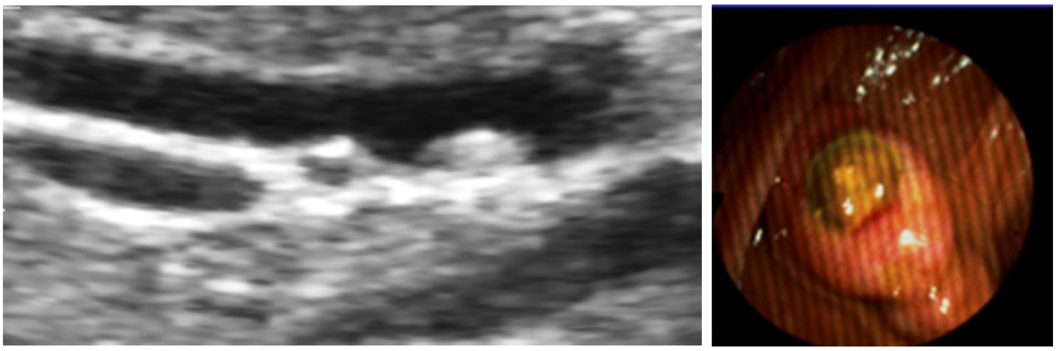


Fig. 4.4.97 a, b Symptomatic choledocholithiasis (several prepapillary concrements!), portal vein and vena cava as well as interjacent right branch of hepatic artery without findings; FS right

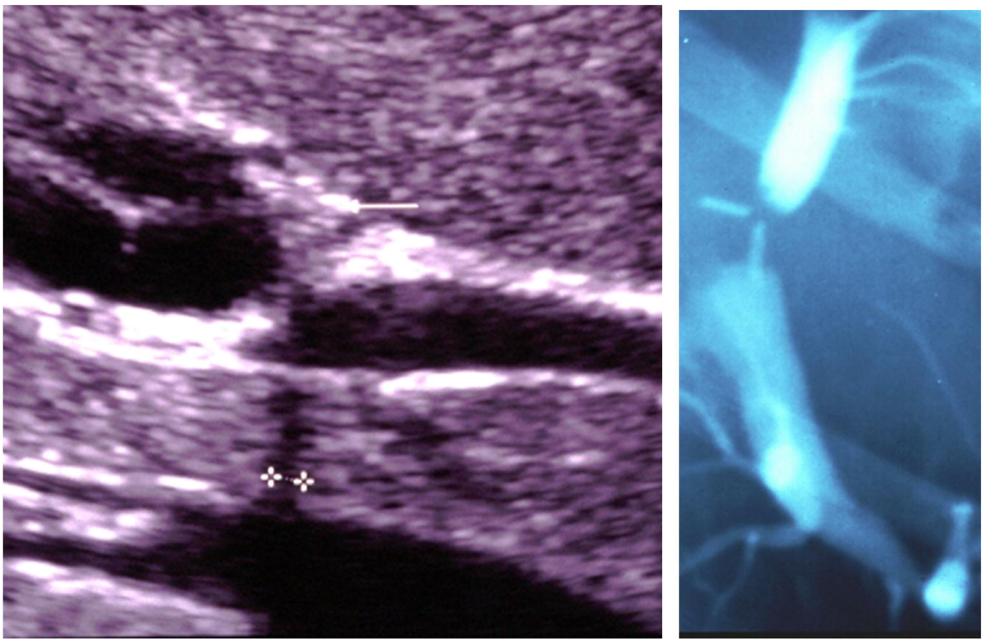


Fig. 4.4.98 a, b After faulty clipping of hepatic bile duct biliodynamic relevant stenosis formation; SCS right (a) and ERCP

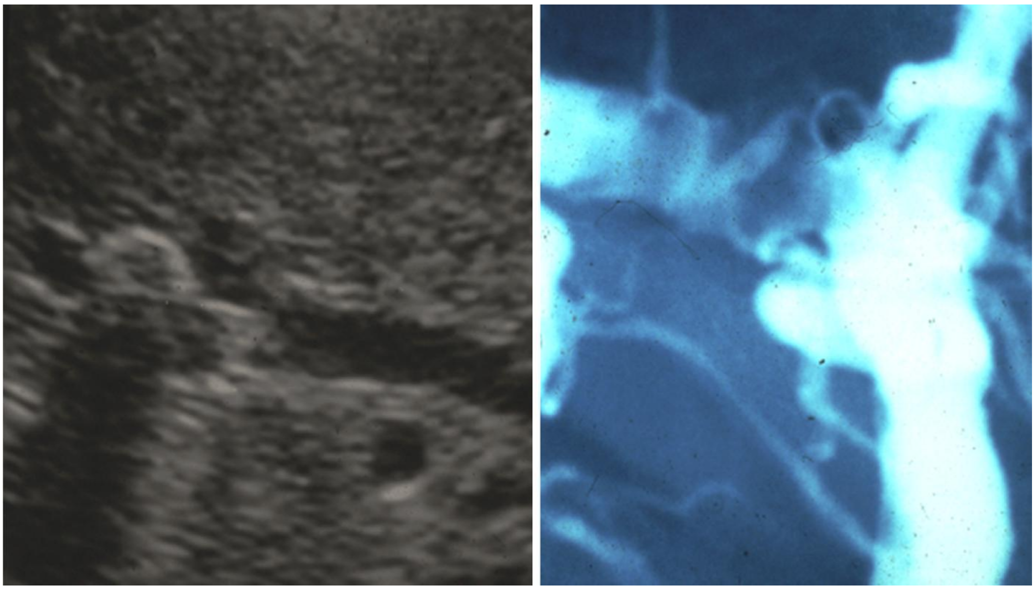


Fig. 4.4.99 a, b Cholangiolithiasis; FS right (b ERCP)

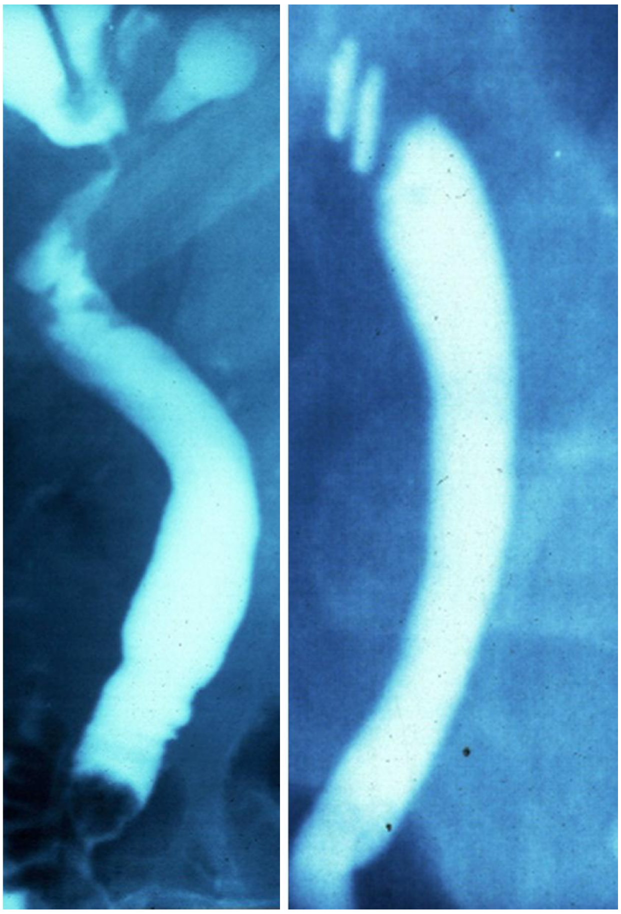


Fig. 4.4.100 a, b The clinically more relevant finding of tumour typical stenosis with accompanying choledocholithiasis was not sonographically diagnosed (a), in an additional case (b) faulty bile duct blockage (so to speak as a maximum credible accident of laparoscopic surgery); ERCP

4.5 Gallbladder

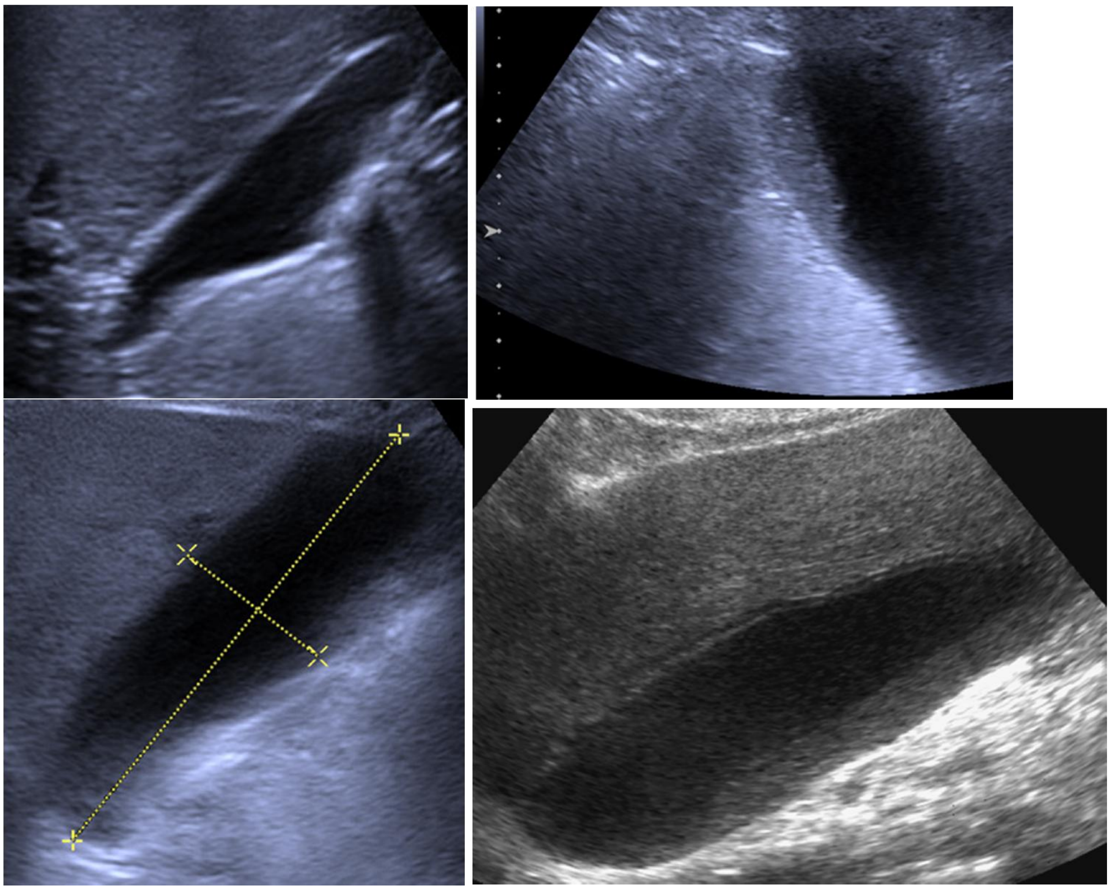


Fig. 4.5.01 a-d Bordering gas-filled bulb (a), sludge (b-d, no visual palpation pain); UAS longitudinal (a, c, d), and SCS right (b)

Fig. 4.5.02 Classic empyema; FS right

In the first instance, the gallbladder has to be found, which can be at times downright difficult. Justifiably it is compared to a bell clapper, which can be located in the small pelvis or up in the upper gastric area, for example in cases of decompensated liver cirrhosis.

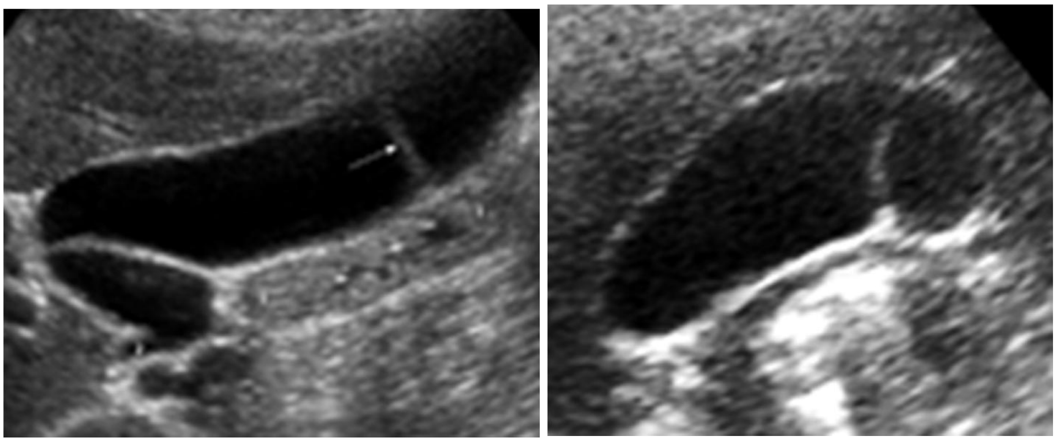


Fig. 4.5.03 a, b Septated (arrow) calculus-free gallbladder, normal duodenum (collapsed (a) or gas-filled (B); FS right

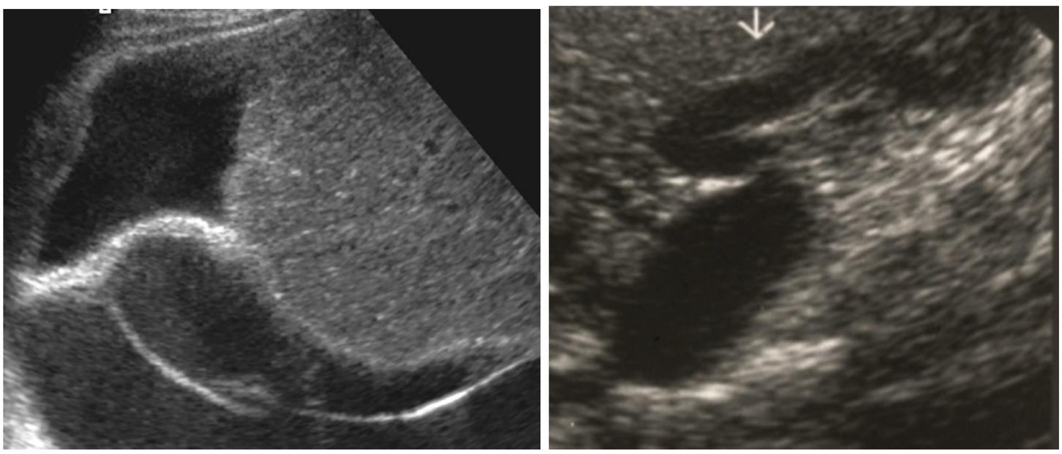


Fig. 4.5.04 a, b Decompensated liver cirrhosis with adhesions (a) and portal hypertension (arrow, b), which simulates a gallbladder.

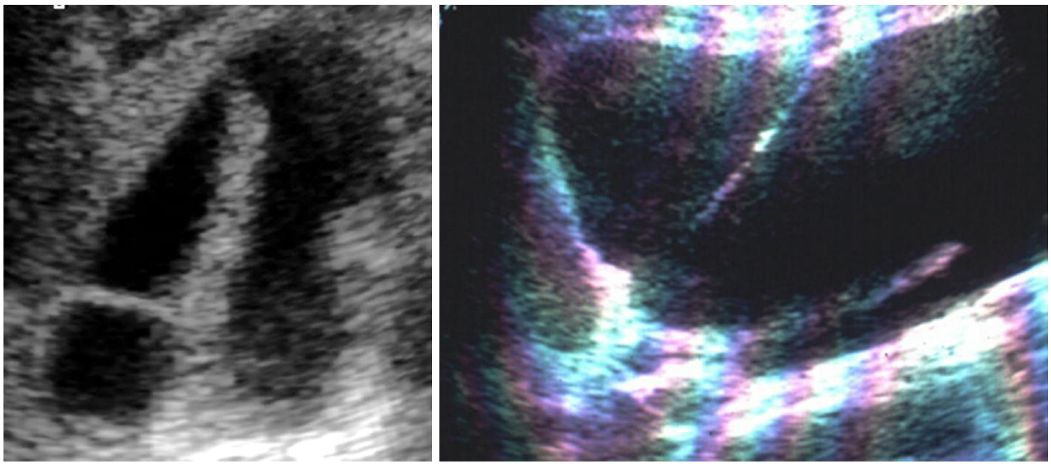


Fig. 4.5.05 a, b	Configuration variations; SCS right (two different cases)

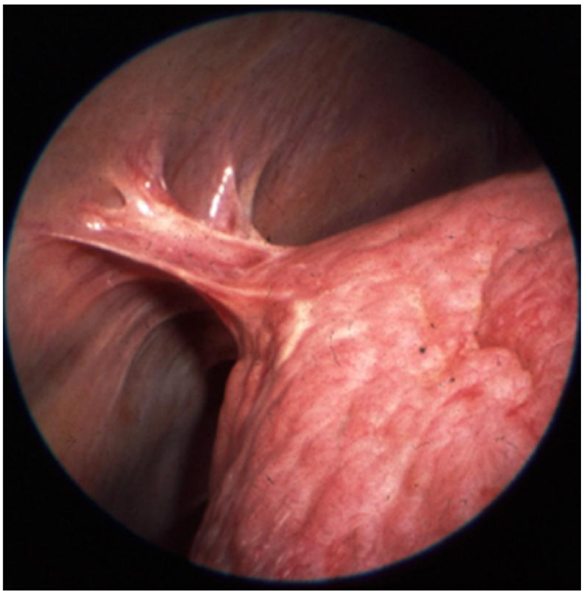


Fig. 4.5.06	Adhesions; laparoscopic view (adhesions often evade sonography)

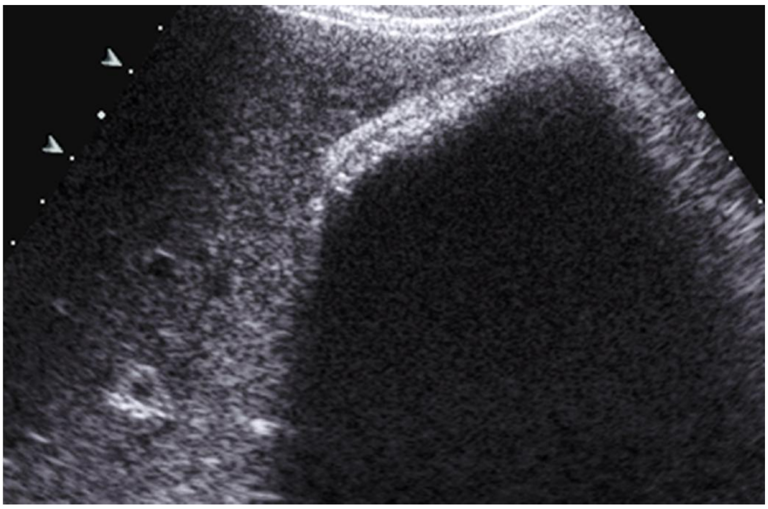


Fig. 4.5.07	Calculus abundant gallbladder; SCS

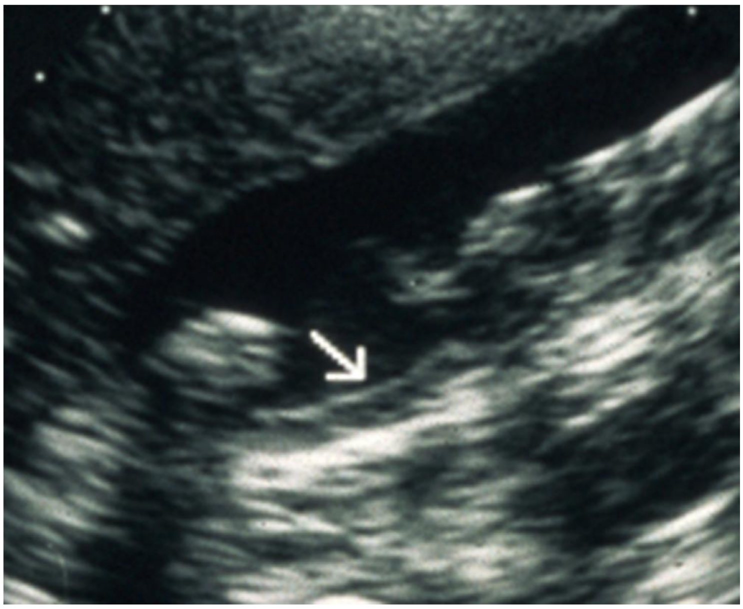


Fig. 4.5.08 Chronic cholecystitis with hypertrophy (arrow); SCS right

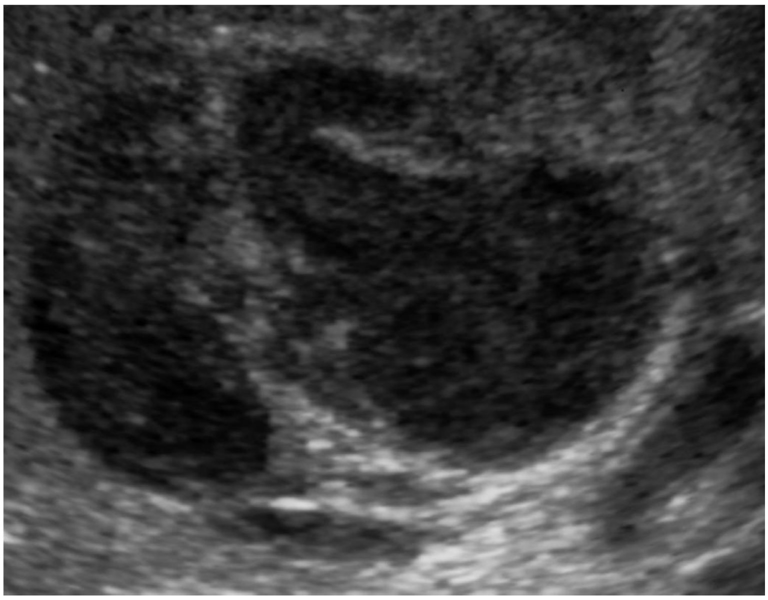


Fig. 4.5.09 Acute lithogenic cholecystitis in multi-septated gallbladder; FS right

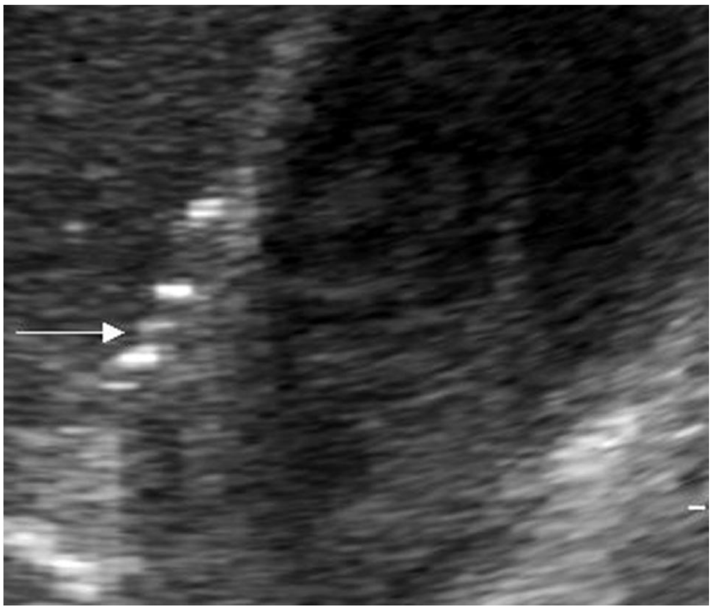


Fig. 4.5.10   Cholecystitis with emphysema and gas (arrow); SCS right

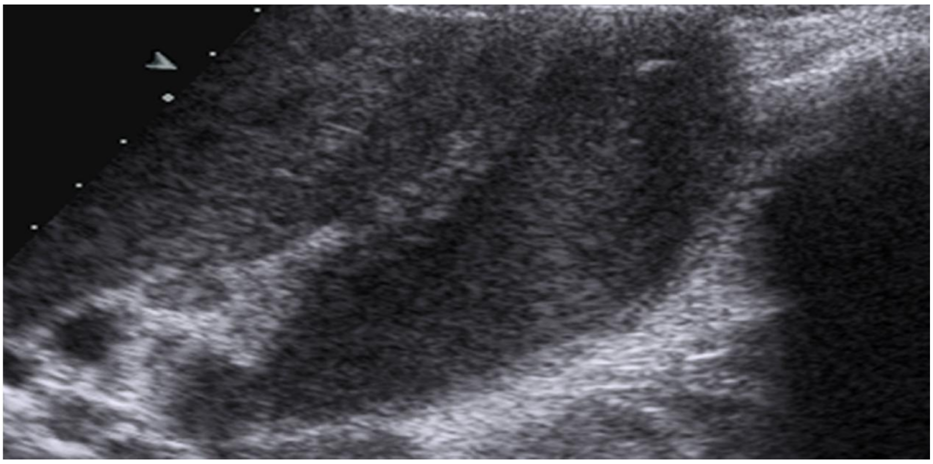


Fig. 4.5.11   Acute cholecystitis with lymphadenopathy and normal hepatic artery and transverse colon, as well as truncated liver sections; FS right

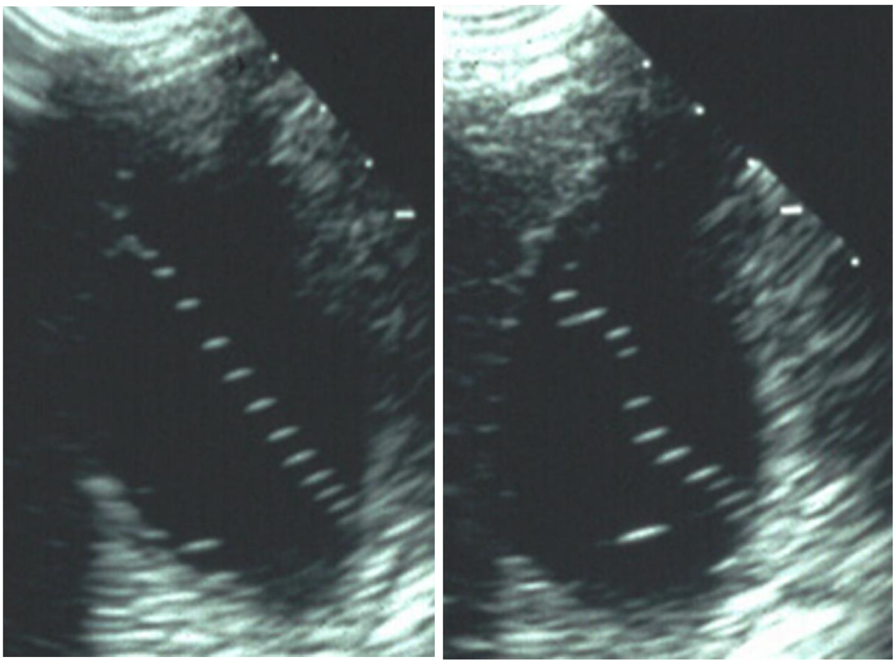


Fig. 4.5.12 a, b After ERCP with CM filling of gallbladder, floating microcalculi in heavier CM, mobile after nudging with finger (b); SCS right

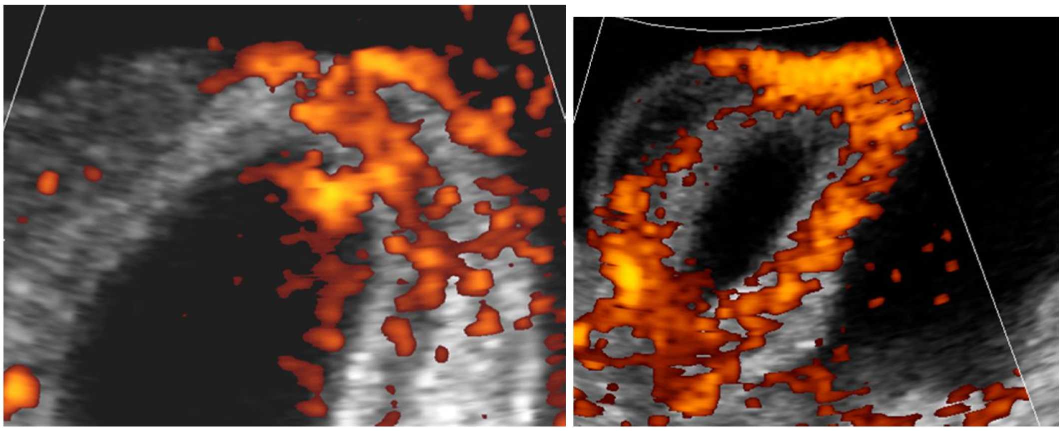


Fig. 4.5.13 a, b Apparent hypertrophy by partially intravesicularly located varices (clinical liver cirrhosis with portal hypertension) (not visible in autopsy) (different cases); UAS longitudinal

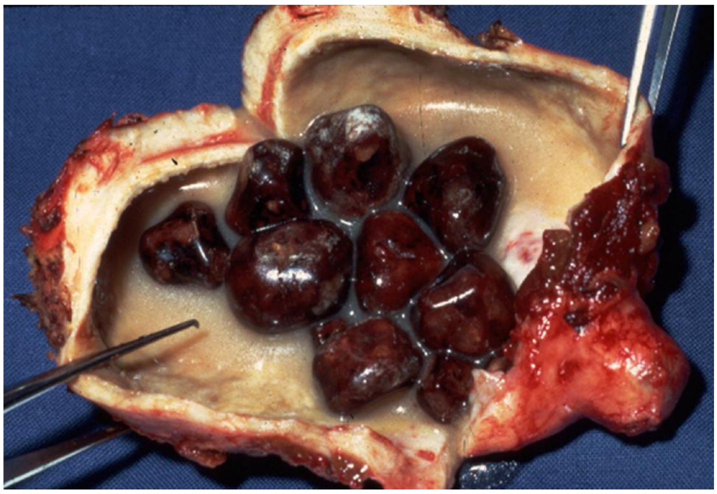


Fig. 4.5.14 Purulent acute lithogenic cholecystitis; surgical specimen

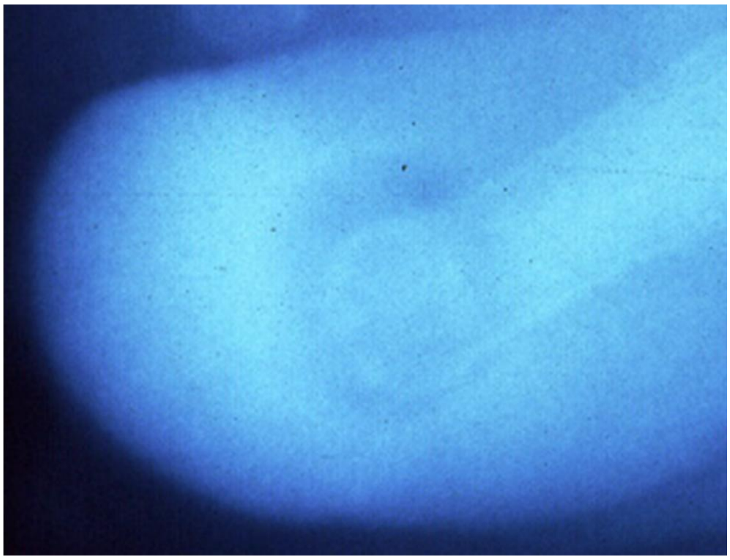


Fig. 4.5.15 Orthograde targeted rib simulates cholecystolithiasis; ERCP

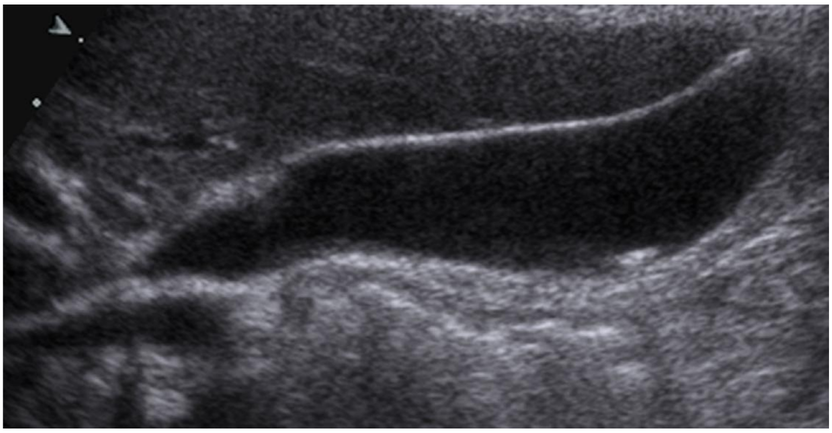


Fig. 4.5.16 Small gallbladder calculus, easily overlooked in relatively large gallbladder; FS right

The lesser the calculi are surrounded by fluid, or the smaller they are; the easier they evade the inattentive ultrasound examiner.

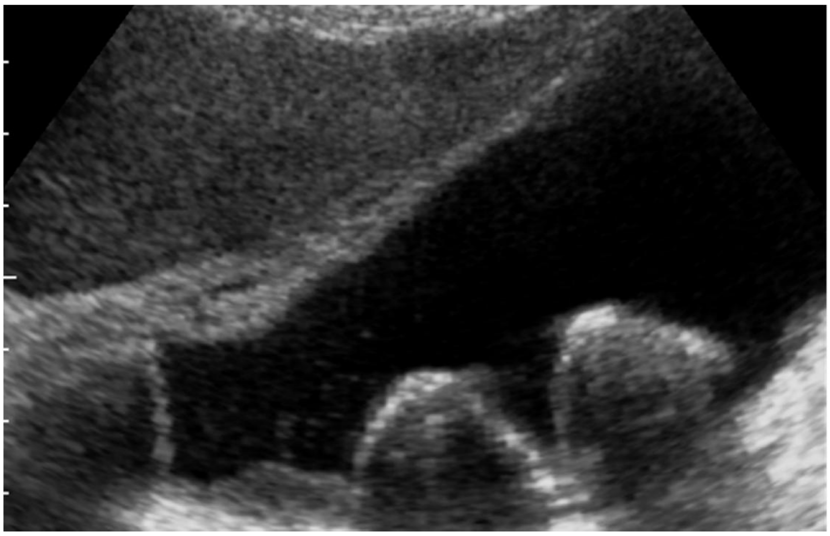


Fig. 4.5.17 Classic cholecystolithiasis; FS right

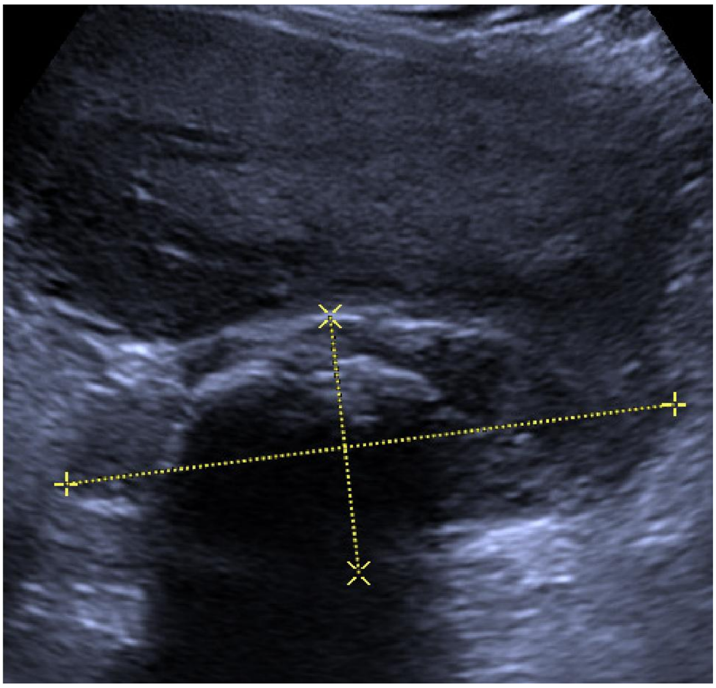


Fig. 4.5.18 Lithogenic acute cholezystitis; UAS longitudinal

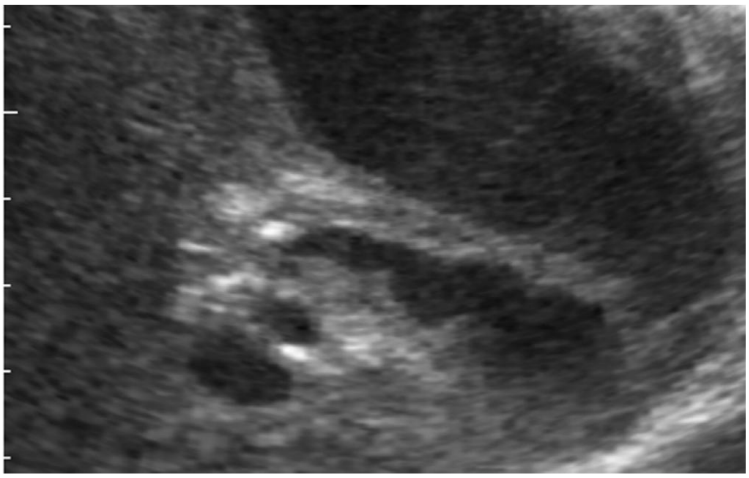


Fig. 4.5.19 Funnel-shaped easily overlooked cholecystolithiasis; SCS right

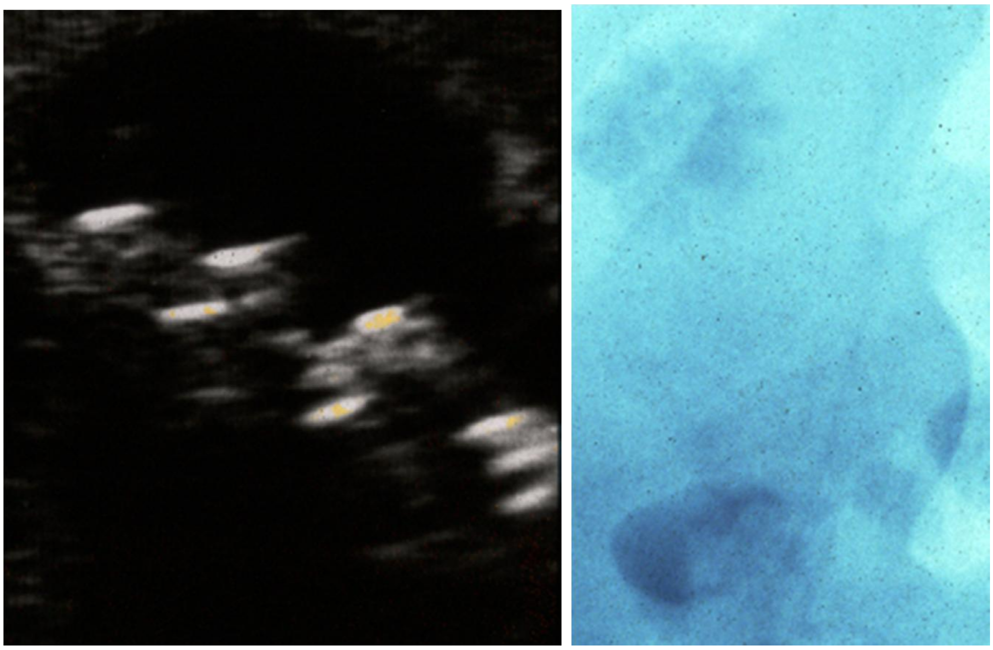


Fig. 4.5.20 a, b Gas-containing gallstones; FS right (a)

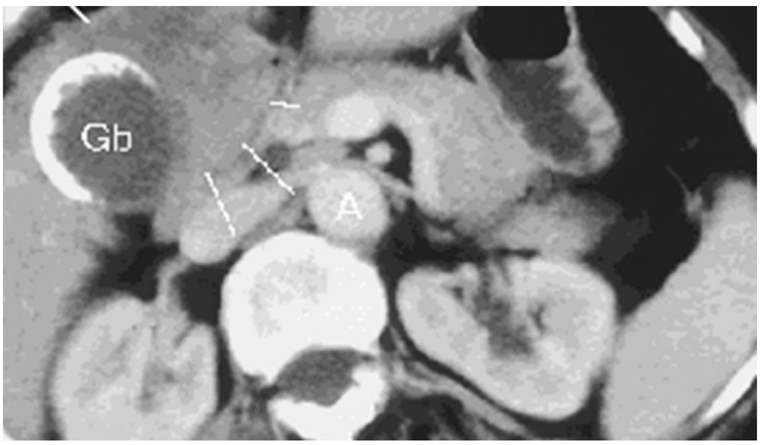


Fig. 4.5.21 Superfluously in CT documented chronic-calcifying hypertrophy-inducing cholecystitis (Gb), A = aorta (normal)

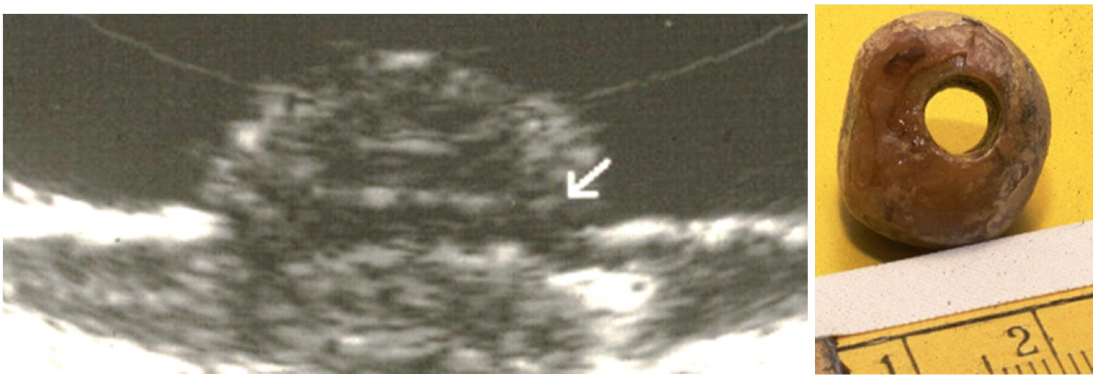


Fig. 4.5.22 a, b Filament with seeming step formation (arrow) (more rapid sound conduction in stone) in drilled gallstone; water bath sections

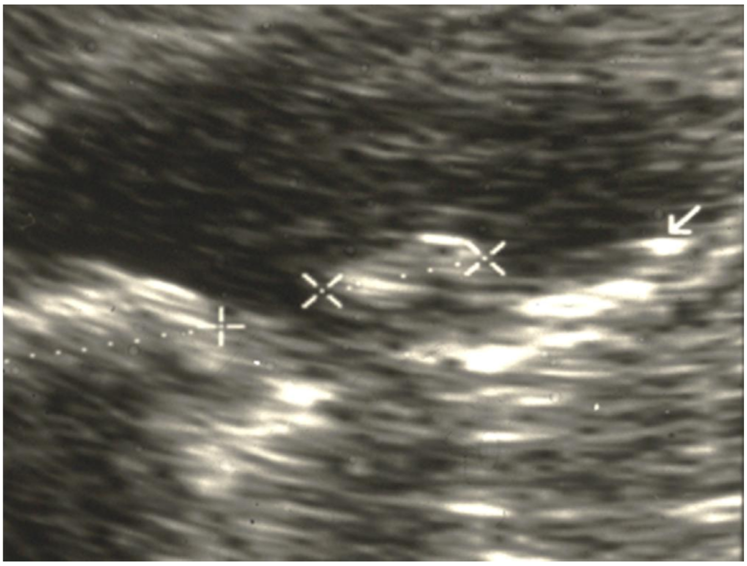


Fig. 4.5.23 Three generations of cholecystolithiasis (arrow: third generation, formed in the respective pregnancies); FS right

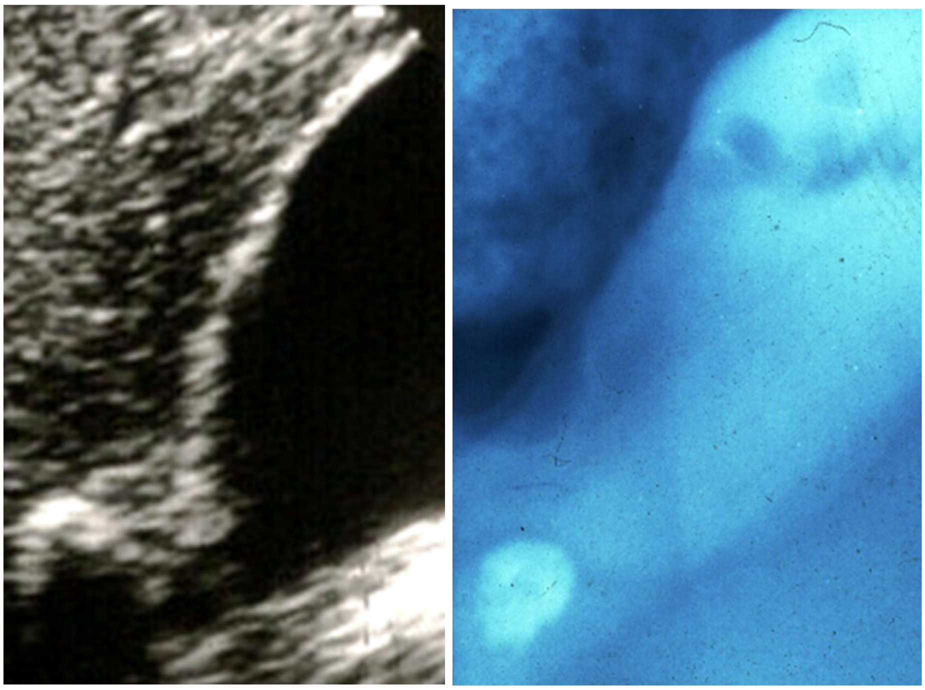


Fig. 4.5.24 Cholecystolithiasis (b similar second case with calcified lymph node and bladder stones); UAS longitudinal and ERCP (b)

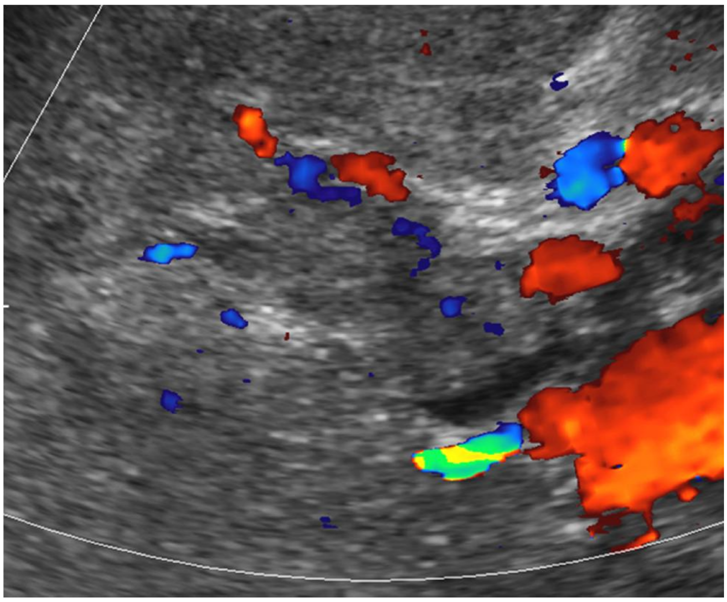


Fig. 4.5.25 Portal-invading and in turn non-definable HCC (with CCDS); FS right

Sludge in virus hepatitis can appear critical, but as a rule it is reversible and asymptomatic.

Also, easily recognizable cholesterol polyps are thought to be harmless, if their diameter does not exceed 10 mm, they then can correspond also to real adenomas, thus precancerous structures. In times of subtle flow measurements this is no longer a problem. Adenomyomatosis of the gallbladder is also thought to be harmless, appearing either generally or segmentally.

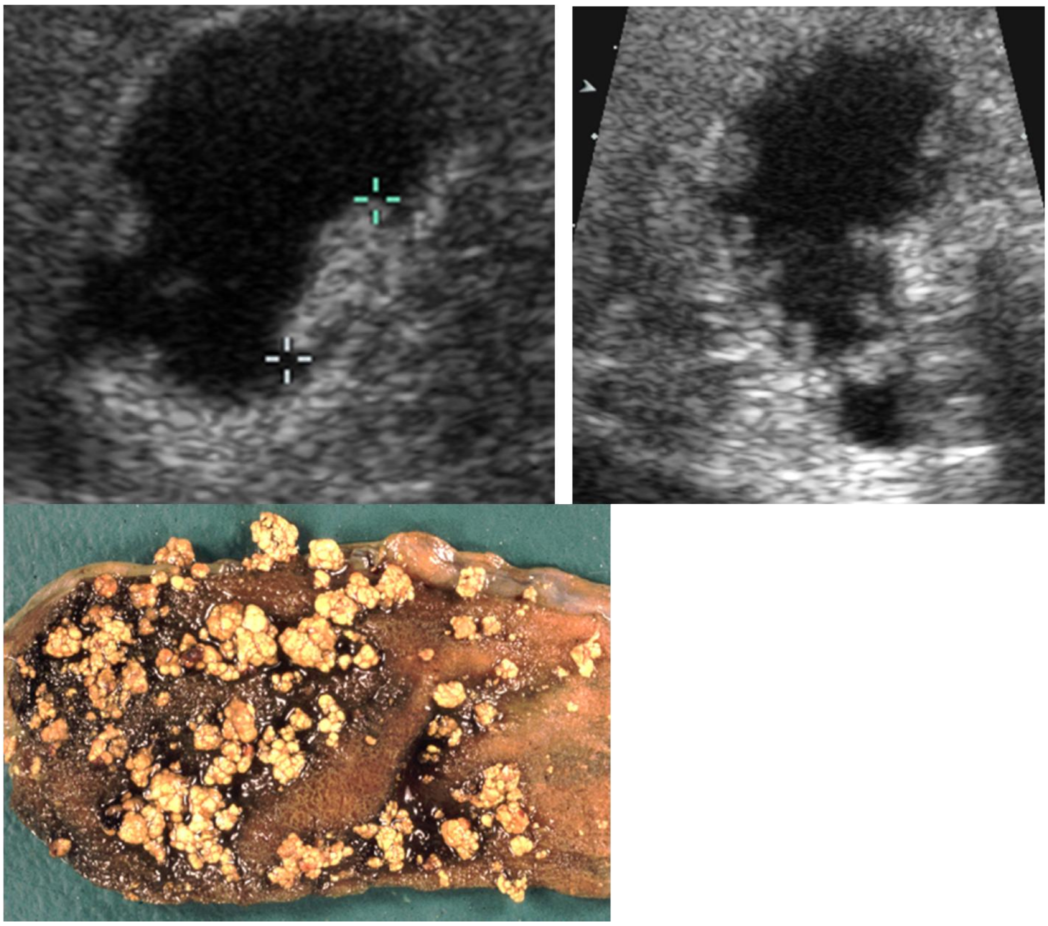


Fig. 4.5.26 a-c Cholesterol polyps singular (a) and multiple (b as well as c) (different cases); SCS right

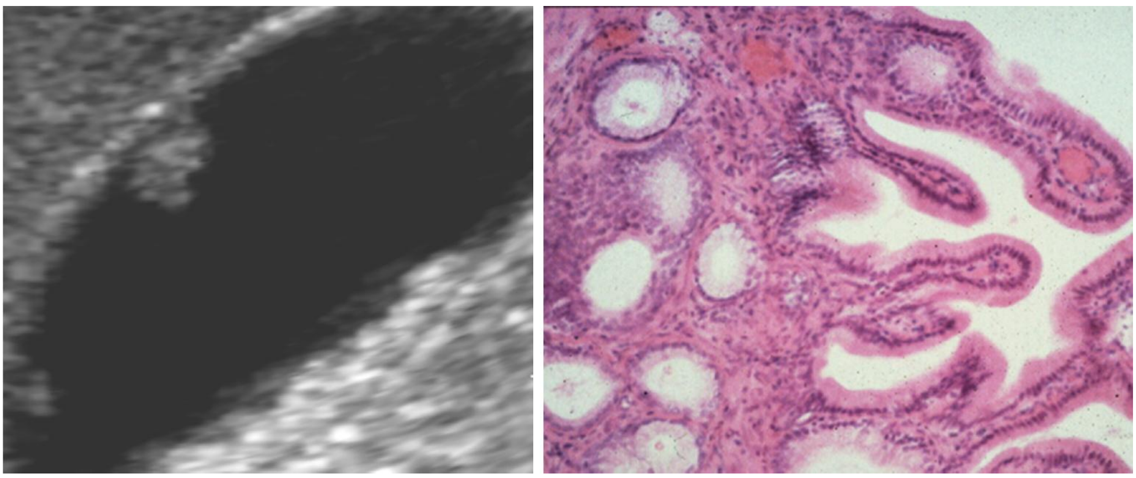


Fig. 4.5.27 a, b Gallbladder polyp and sludge (a) and, in contrast to gallbladder stones, locally set cholesterol polyp not migrating to the lowest point of the gallbladder (histological b); FS right

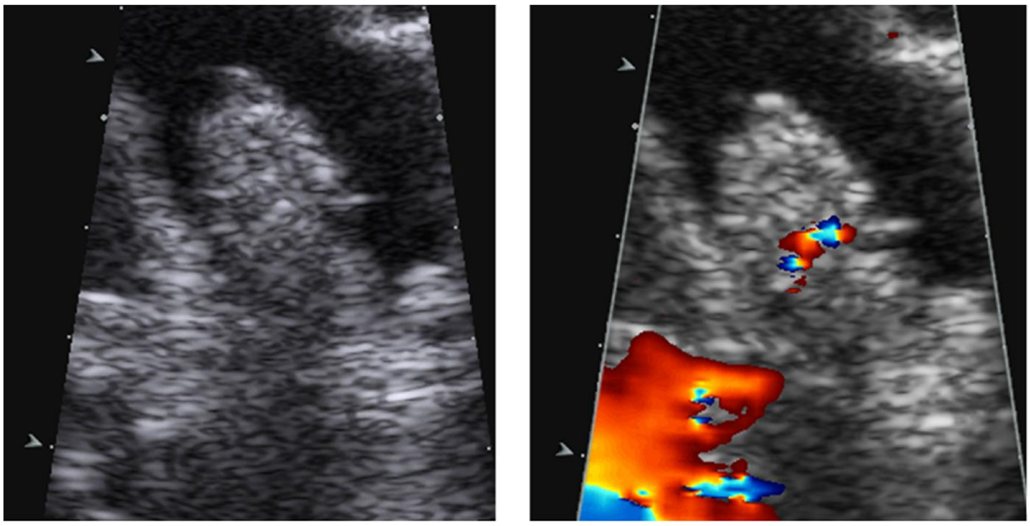


Fig. 4.5.28 a, b Gallbladder adenoma, colour coded sonography with proof of perfusion (b); FS right with CCDS

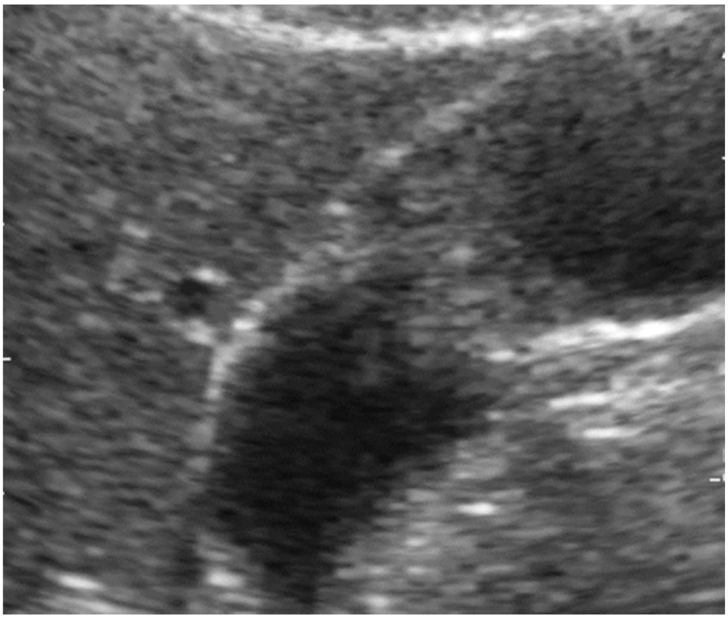


Fig. 4.5.29 Segmental adenomyomatosis of the gallbladder, UAS right

The sometimes obvious temptation to count gallstones should be forgone in favour of the more summarized information of a cholelithiases. Otherwise, a different count may result from surgery, and the faulty accuracy of the method is unjustly questioned.

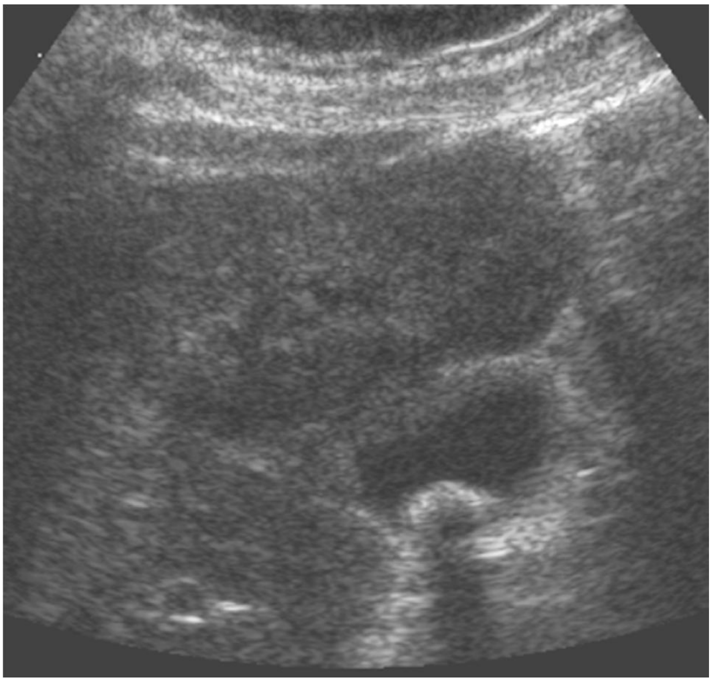


Fig. 4.5.30 Ultimately asymptomatic cholecystolithiasis as a secondary diagnosis; the clinical main finding is HCC, which is visible as a poorly definable hypoechoic FL situated ventrally of gallbladder; FS right

Fig. 4.5.31 Acute hypertrophy-inducing cholecystitis, gallstones are not in the section plane; FS right

The respectively clinically more relevant findings must be assessed individually and in correct clinical context.

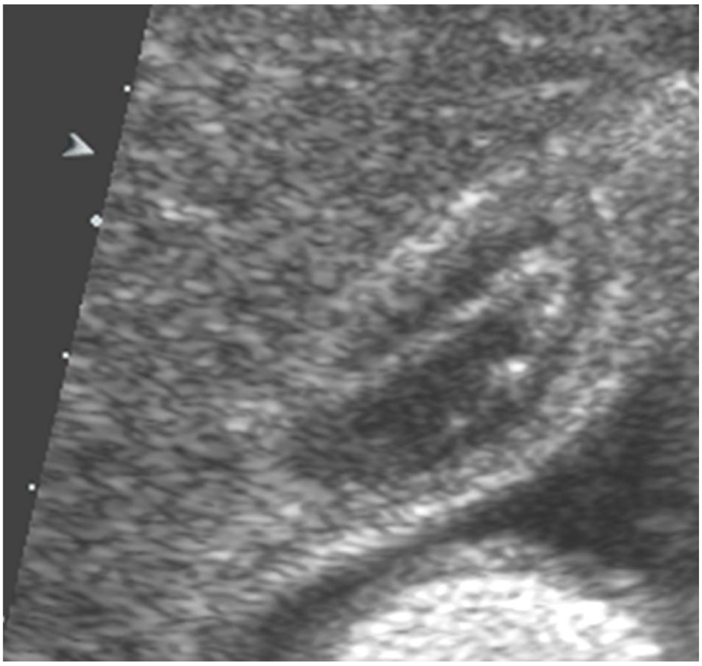


Fig. 4.5.32 Membranous cholecystitis, ascites and stones known from history; FS right

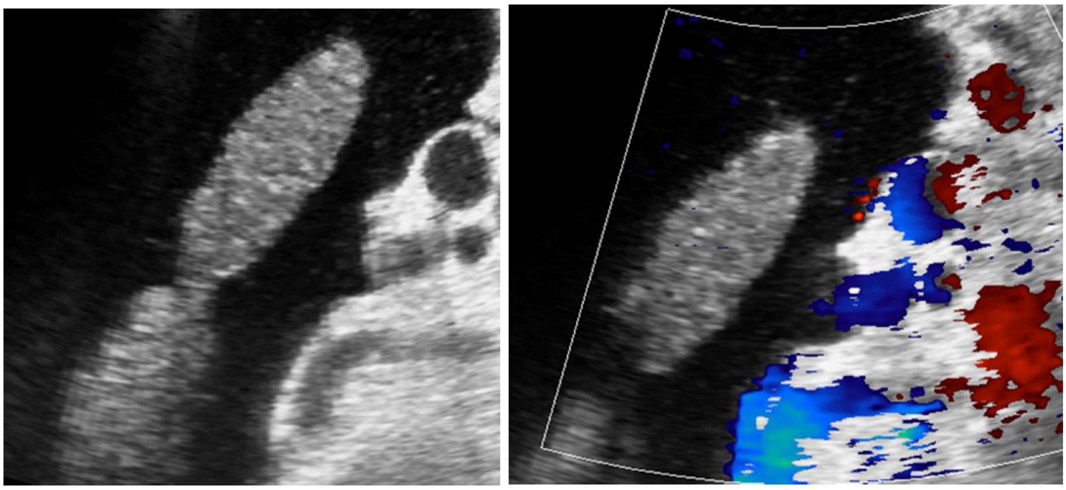


Fig. 4.5.33 a, b Portal hypertension with retroperitoneal varices; FS right (b with CCDS)

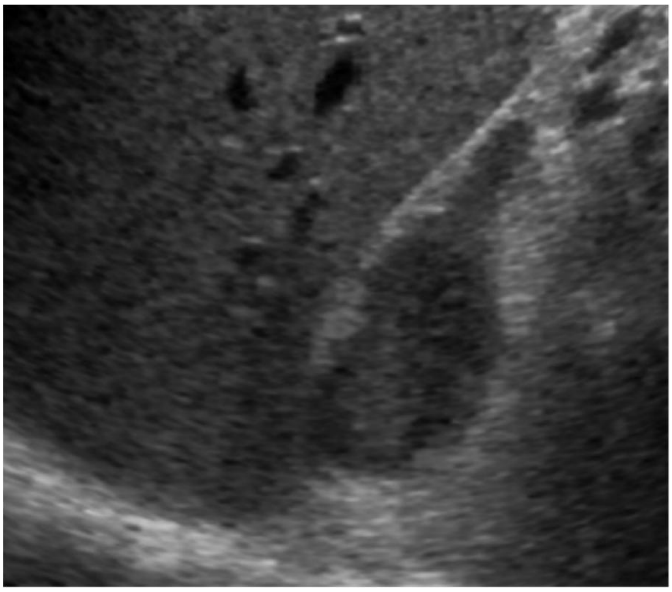


Fig. 4.5.34 Tumour thrombosis of inferior vena cava, no focal lesion of liver (clinical renal tumour); FS right

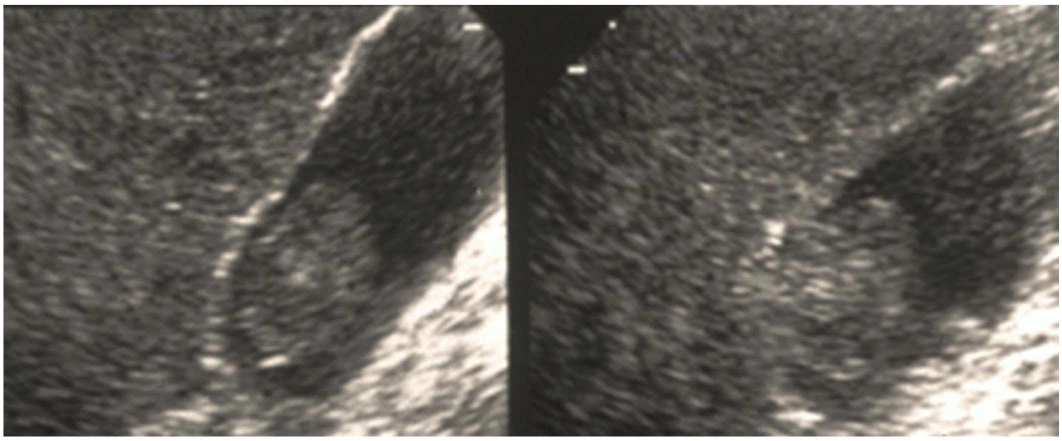


Fig. 4.5.35 a, b Otherwise hardly definable HCC, infiltrating the gallbladder; FS right

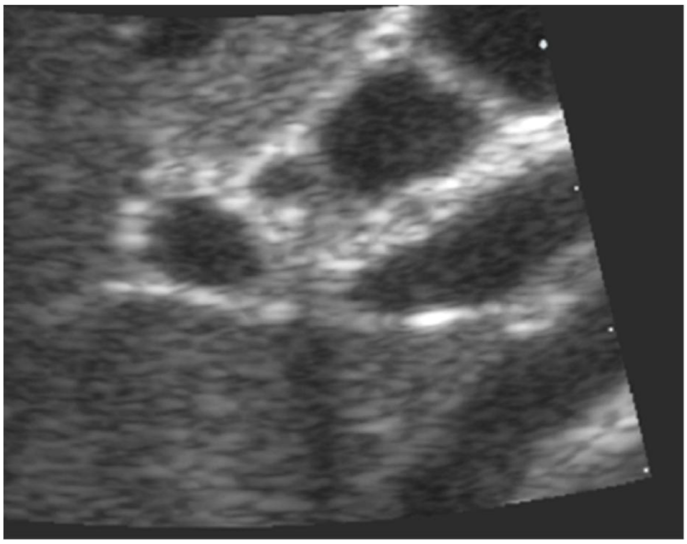


Fig. 4.5.36 Symptomatic and funnel-shaped hidden cholecystolithiasis of minor size surrounded only with little fluid; FS right

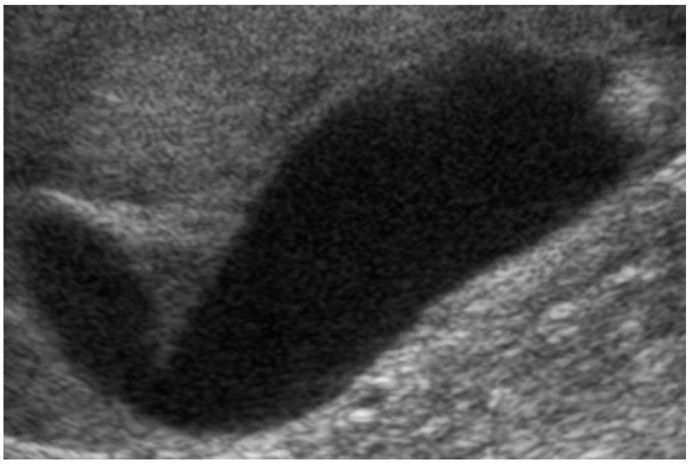


Fig. 4.5.37 Cholecystolithiasis located hidden in fundus; FS right

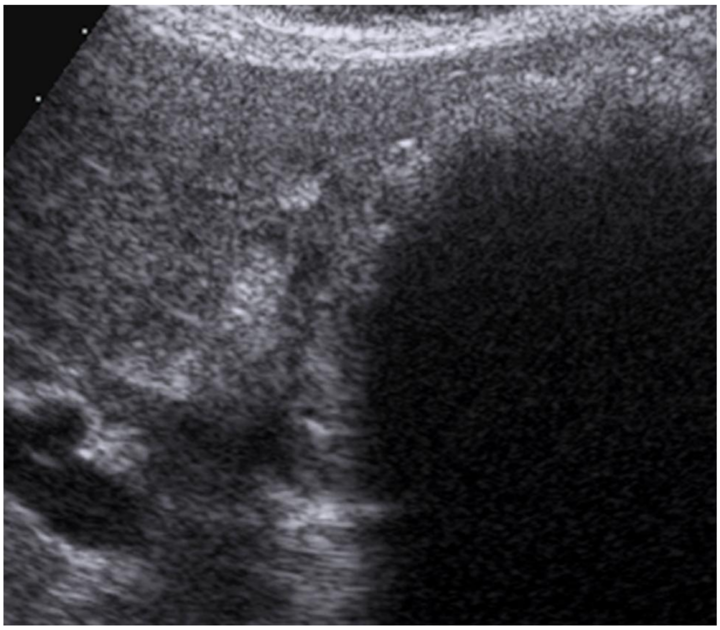


Fig. 4.5.38 Completely calculus filled sclero-atrophic cholecystitis; FS right

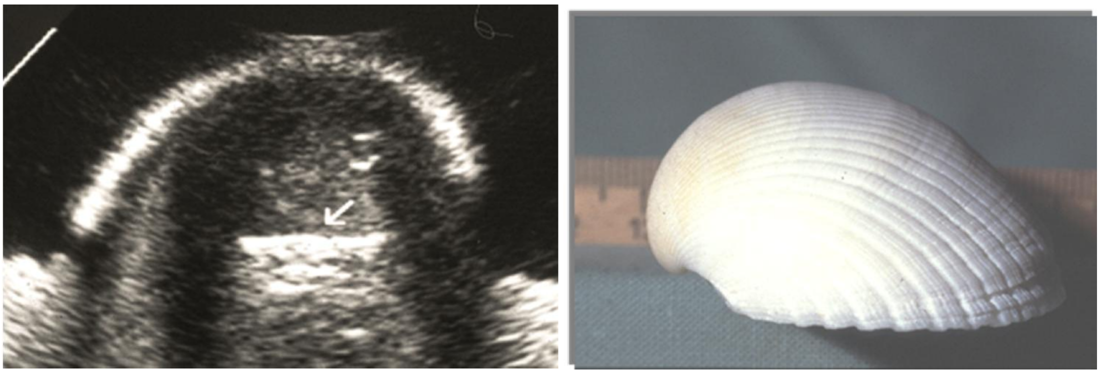


Fig. 4.5.39 a, b Scanning of thin calcium oxide membranes; water bath, coin (arrow in a)

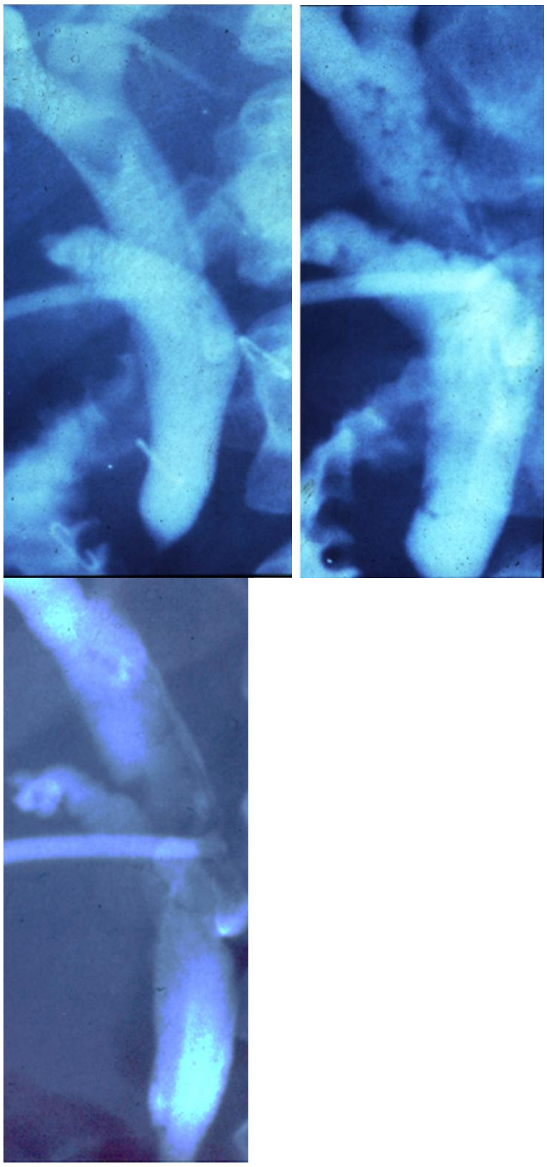


Fig. 4.5.40 a-c Gallstone (forgotten during surgery) before ESWL, immediately after and (free of calculus) the next day (from left to right): avoidance of repeated surgery, easier imaging via T-drainage

The ratio of sonographically verified gallstones is specified in the literature to be about 70%.

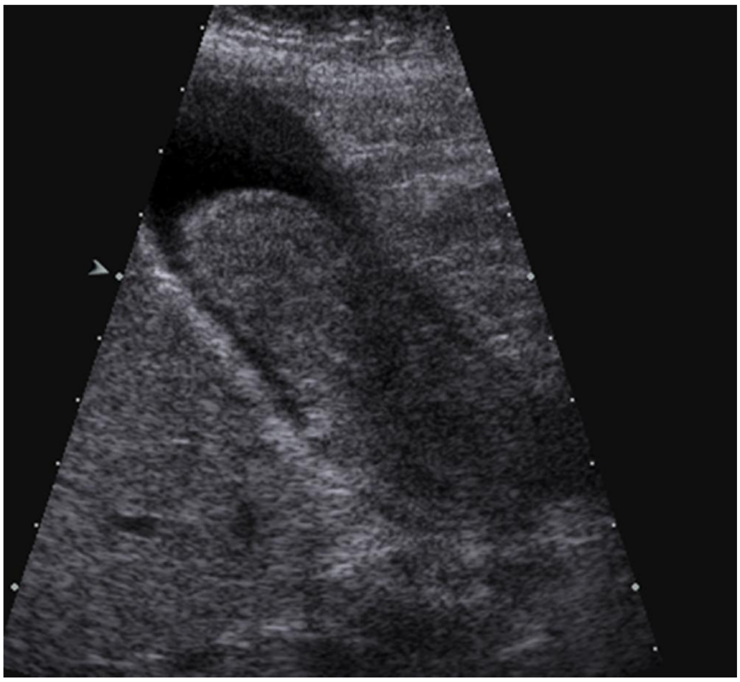


Fig. 4.5.41 Abundant amounts of gallbladder sludge; SCS right

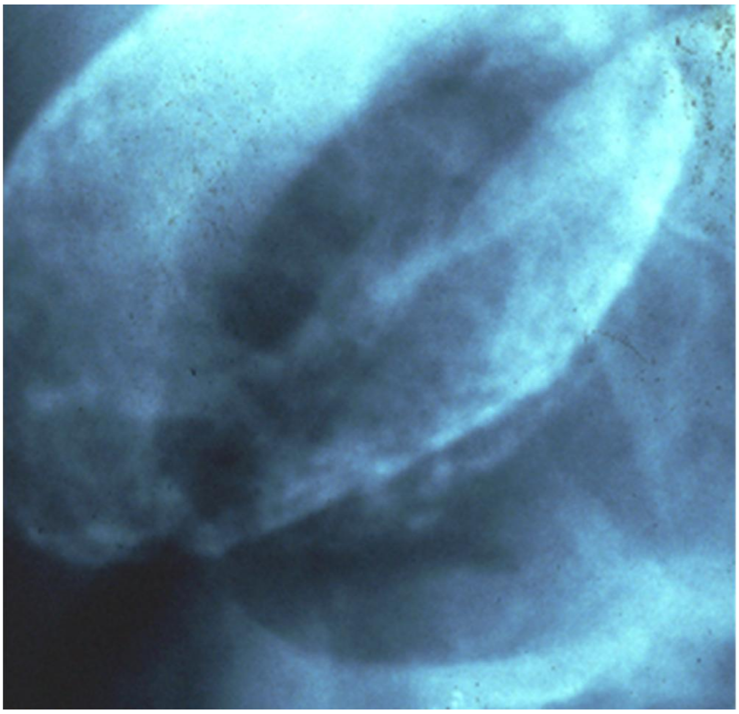


Fig. 4.5.42 Porcelain gallbladder; FS right

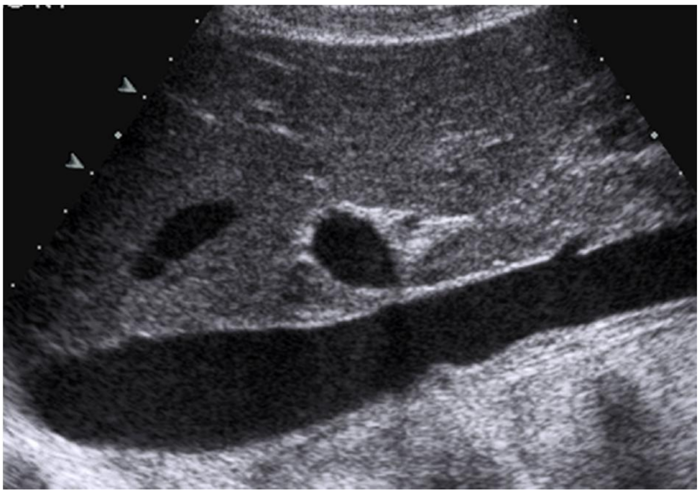


Fig. 4.5.43   With inspiration congested inferior vena cava, normal also pre-vertebral right renal artery as well as liver; UAS longitudinal

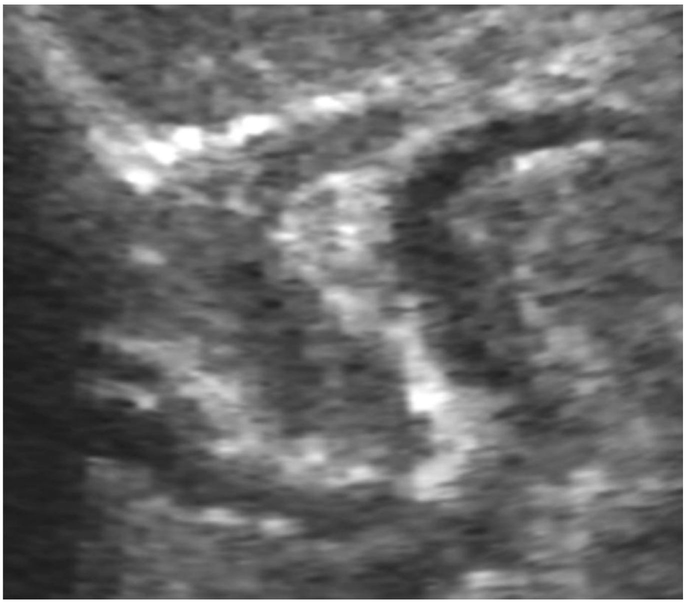


Fig. 4.5.44   Thrombosis of intrahepatic portal vessel branches segment II; UAS transverse

Fig. 4.5.45 Sonographically hardly detectable cystic duct trunk calculi juxtapapillary duodenal diverticulum

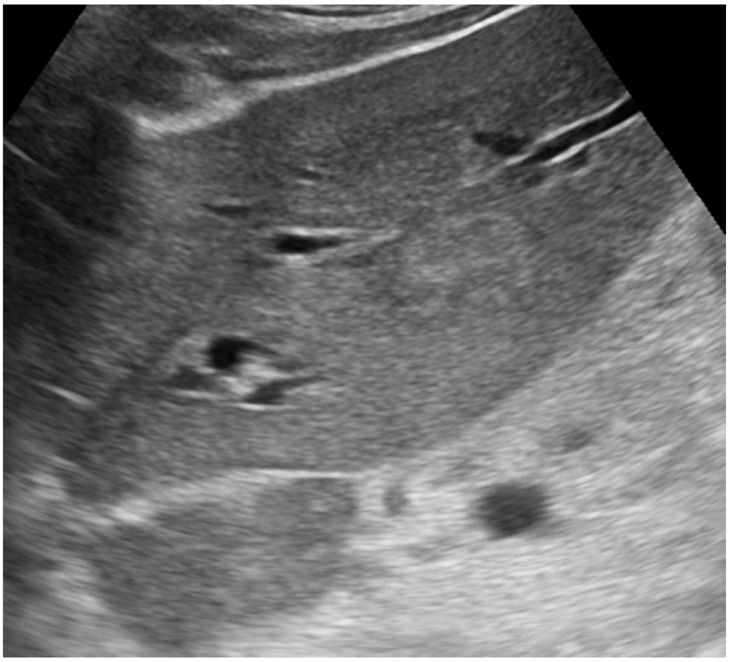


Fig. 4.5.46 Focal lesion recognizable only after taking a closer look; FS right

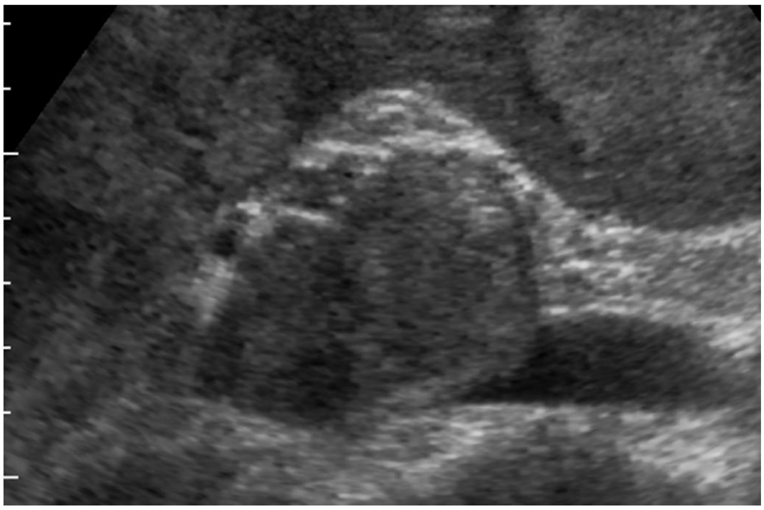


Fig. 4.5.47 Compressing lymphadenopathy, hepatic metastases; UAS transverse

Please note:

- **adapt section planes to individual situation**
- **pay attention to anatomic situation**
- **correlate medical and clinical chemistry data**

4.6 Pancreas

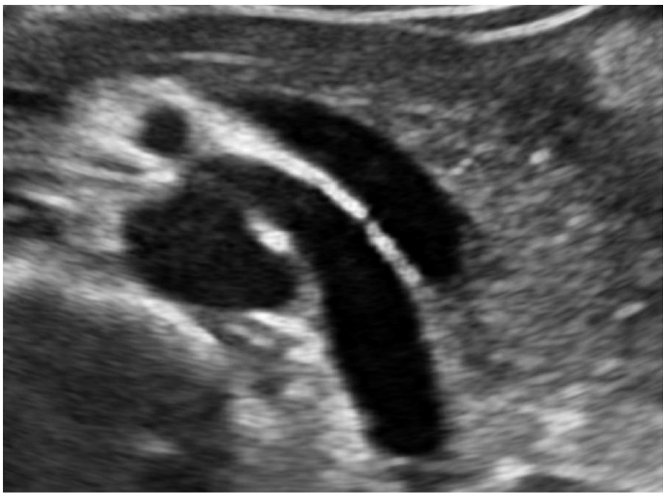


Fig. 4.6.01 Pancreas body bent in a typical way and congested left renal vein; UAS transverse

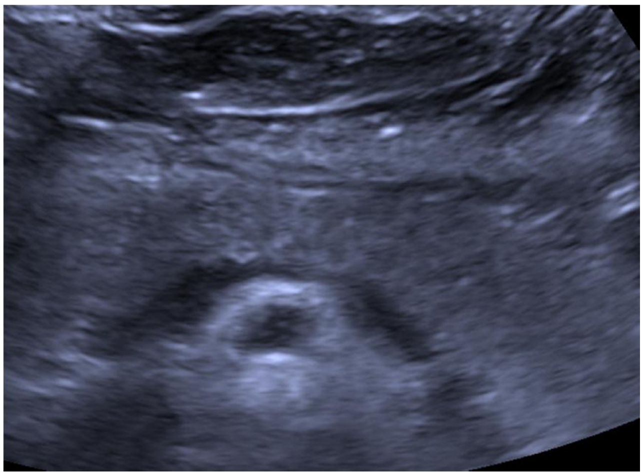


Fig.4.6.02 Pancreas in its limitations to antrum posterior wall (b); UAS transverse

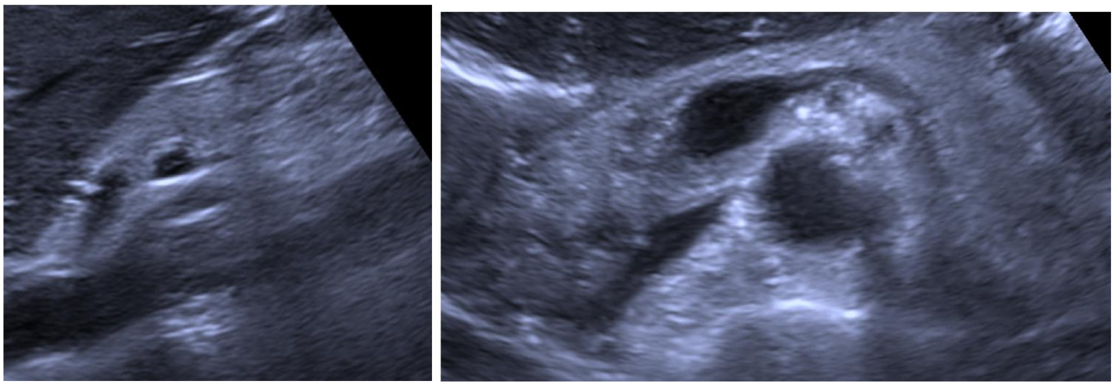


Fig. 4.6.03 a, b Typical course of pancreas in LS (a) with superior mesenteric and hepatic arteries, and splenic vein in LS as well as transverse (b), splenic vein, superior mesenteric artery, left renal artery, inferior vena cava, and arteries UAS transverse

Fig. 4.6.04 Subsiding acute pancreatitis; cross-sections right

Pancreas sonography is known as the higher art of ultrasound diagnostics. This is because the imaging of a deep and hidden acapsular organ, particularly its "sono-unfriendly" meandering pancreas tail, is highly demanding for the examiner. For the overall rather infrequent pancreas findings there is conversely a very broad differential diagnosis of illness entities. Furthermore focal changes, especially the small ones, necessitate additionally routine supplemental endosonography, which becomes with the highest resolution in the hands of the "experienced" the final diagnostic authority before the pathologist.

Perioperative, best in the hands of the operator, sonography yields indispensable information (Bunk).

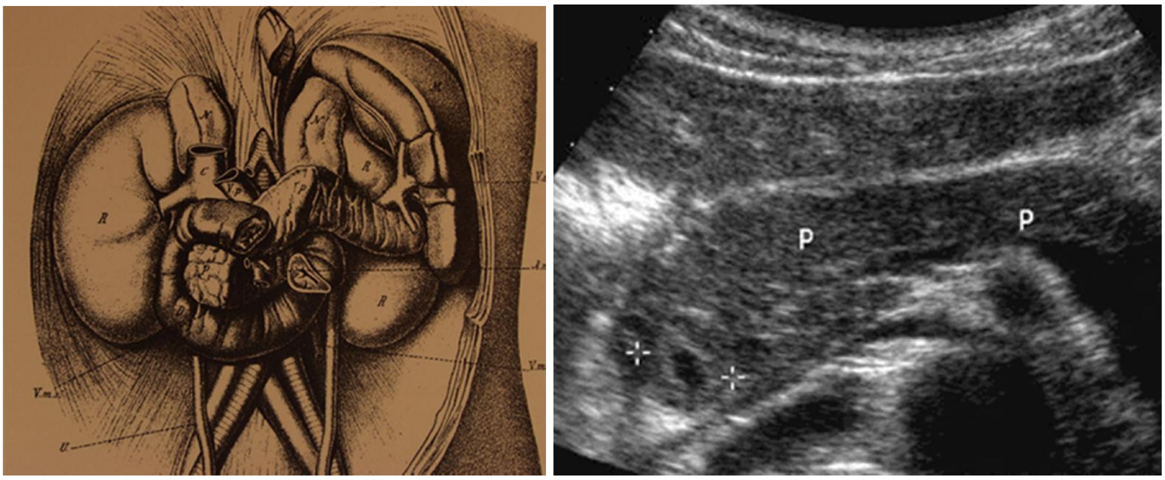


Fig. 4.6.05 a, b Correct image of the pancreas (P) schematically represented (a) and in the sonogram, whereby there still is a high degree of variability in the height of the tail position, typical gas accumulation in the bulb, normal is also the inner contour of the duodenal C, as well as inferior vena cava, left renal vein (ventral to the also normal abdominal aorta), as well as splenic vein, after EPT slightly hypertrophied bile duct (crosses); UAS transverse

Pancreas imaging with possibly targeted palpation is routine part of the sonographic upper abdominal status. Form, size and internal structure are described, and it is paid attention to the imaging of the pancreatic duct inside the pancreas body. Imaging of the entire gland (including tail region) is done in the right lateral position and deep inspiration.

In every suspected case of a pancreatic illness, competent and complete pancreas sonography with imaging of the pancreas tail is indicated as the first imaging procedure, also in the sense of a second opinion examination.

This is also valid for patients with upper abdominal complaints with unclear aetiology.

As a remnant of pancreatic development, the dorsal part of the uncinate process, corresponding to the ventral annular pancreas, may appear somewhat hypoechoic.

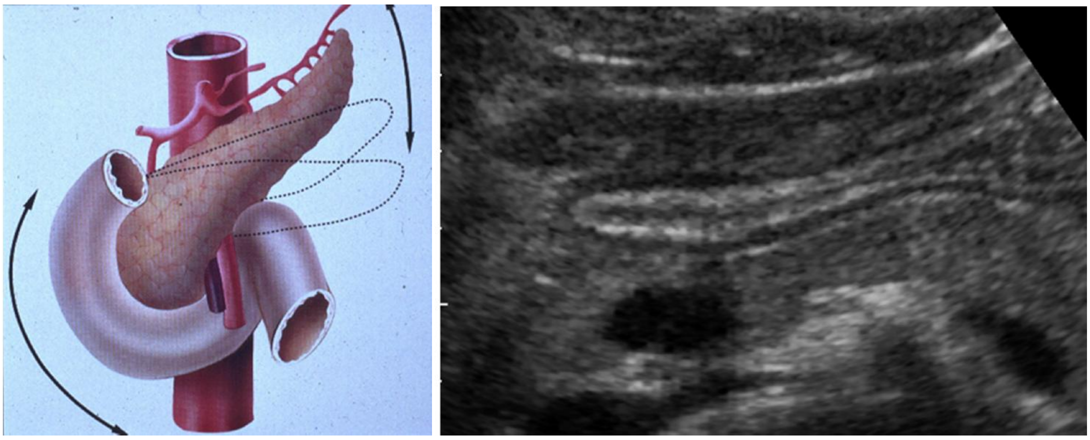


Fig. 4.6.06 a, b Variability of pancreas tail, gastroduodenal artery and duodenum, and normal sonogram with anterior and posterior antrum wall, as well as optimal imaging of antrum corpus anterior and posterior wall (b); UAS transverse

Frequently the pancreas is depicted falsely in textbooks and other publications: In many schematic pictures the body and particularly the tail area appear wrongly elongated and not, which would correspond to anatomic reality, perpendicularly bent between head and body. The tail region can be, individually varying, shifted cranially.

This somewhat complex and to an extent "sono-unfriendly" anatomy is best counteracted by high positioned cross-sections (at the xyphoid) in deep inspiration, whereby the left liver lobe then can serve as a sono-acoustic window. Thereby the transducer runs in parallel to the splenic vein as a guiding structure, which virtually rides lengthwise on the pancreas.

Calcifications in chronic pancreatitis are just as well to be documented as parenchyma reductions – as seen by a diminished gastroduodenal artery at the confluence - and duct dilations.

Fig. 4.6.07 Chronic-pancreatic parenchyma reduction of the pancreas, apparent distance reduction of gastroduodenal artery and hepatic bile duct (lower cross-sections, minor congestion) and pancreatic duct (upper cross-sections) to splenic vein (to confluence), normal flat inferior vena cava, note interior mucosa of the duodenal C; UAS transverse

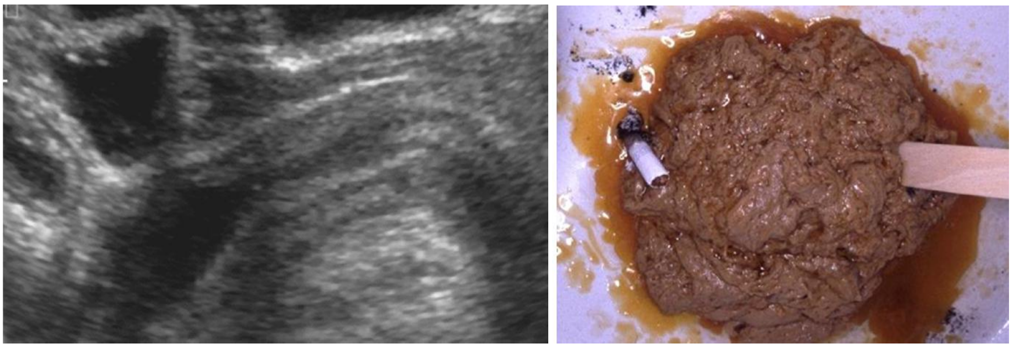


Fig. 4.6.08 a, b Chronic pancreatitis and inflamed dilated small intestinal loops (a), splenic vein normal, also the rectangular course of the pancreas tail and, also visible, the superior mesenteric artery and antrum, as well as the fluid-filled bulb with bordering antrum (ventrally), steatorrhea ("it smells like French fries with my cigarette extinguished after defecation"(b)); UAS transverse (a)

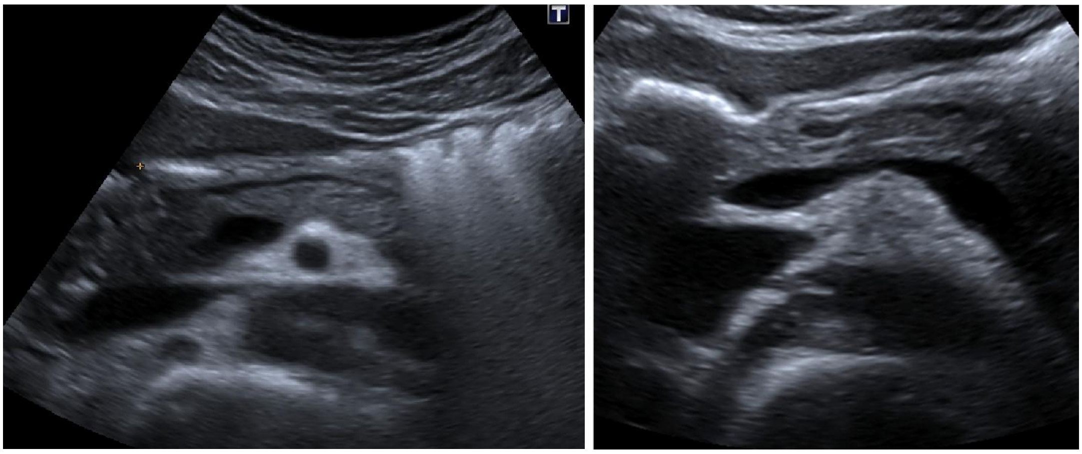


Fig. 4.6.09 a, b Normal narrow pancreas, gas in transverse colon (b) as well as in bulb, normal antrum posterior wall (no pancreatic duct!), pylorus; UAS transverse

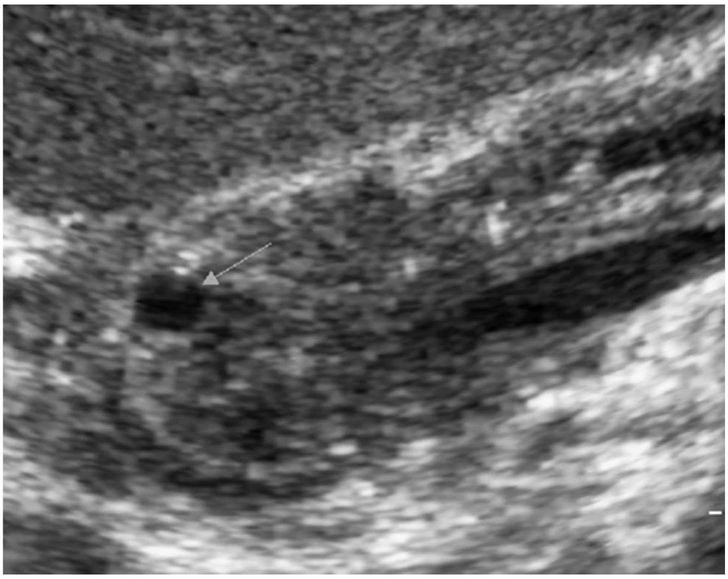


Fig. 4.6.10 Chronic pancreatic parenchyma reduction, pancreatic duct slightly dilated, gastroduodenal artery (arrow), and duodenum normal, also splenic vein; UAS transverse

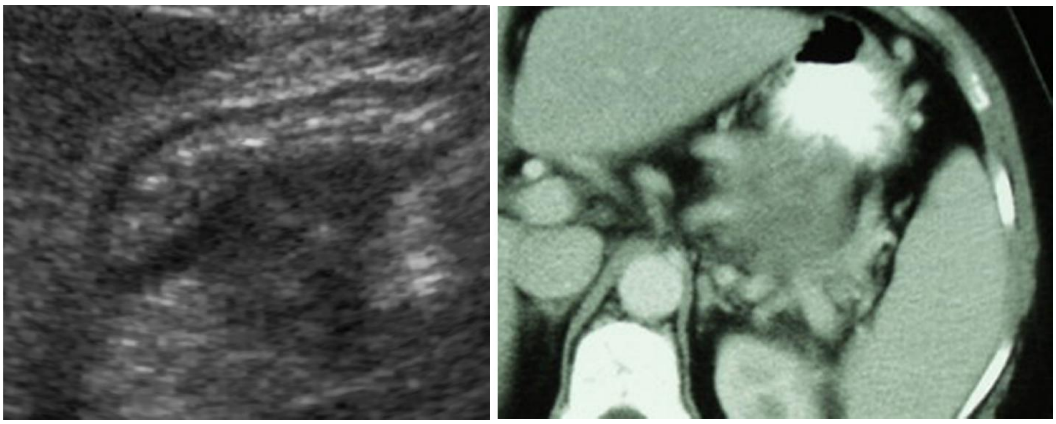


Fig. 4.6.11 a, b Stomach invading pancreatic head tumour, no additional information from CT (b); SCS right (a)

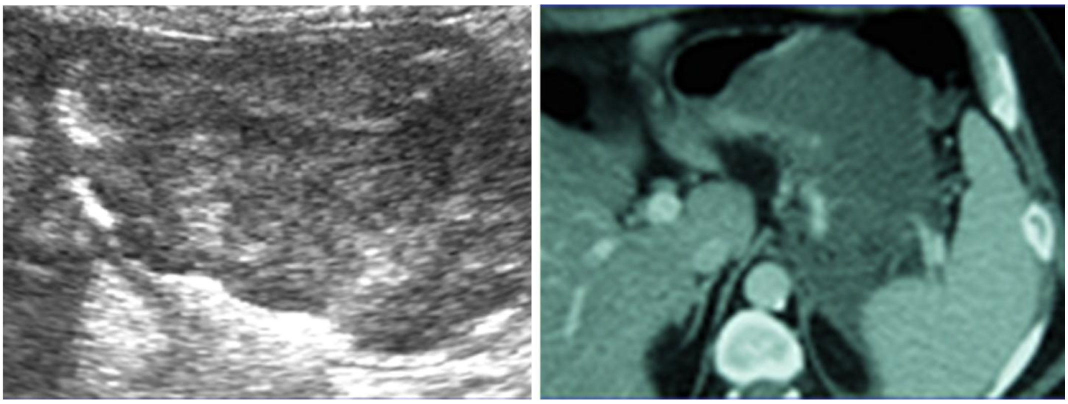


Fig. 4.6.12 a, b Gastric tumour, no pancreatic space occupation; SCS left (a)

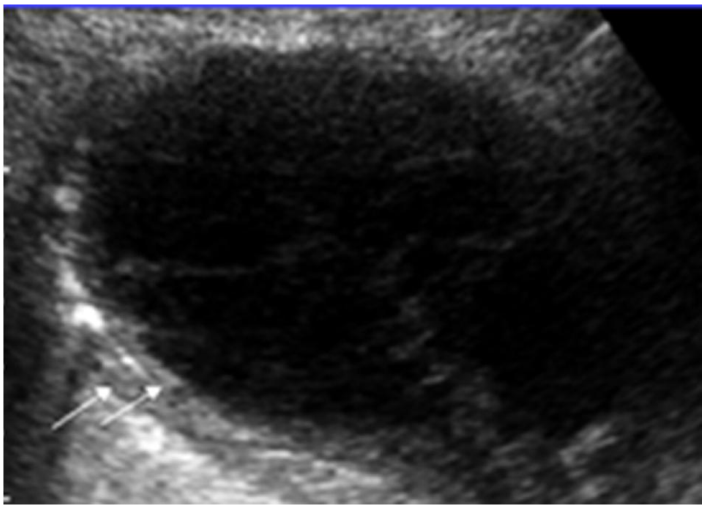


Fig. 4.6.13 Large pseudocyst with respective stomach compression (arrows: anterior and posterior gastric wall); UAS transverse

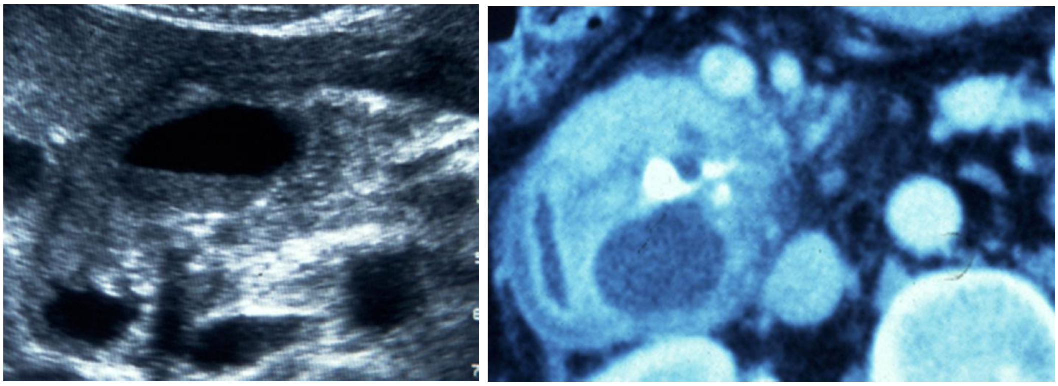


Fig. 4.6.14 a, b Pseudocyst in chronic pancreatitis; UAS transverse (b CT image)

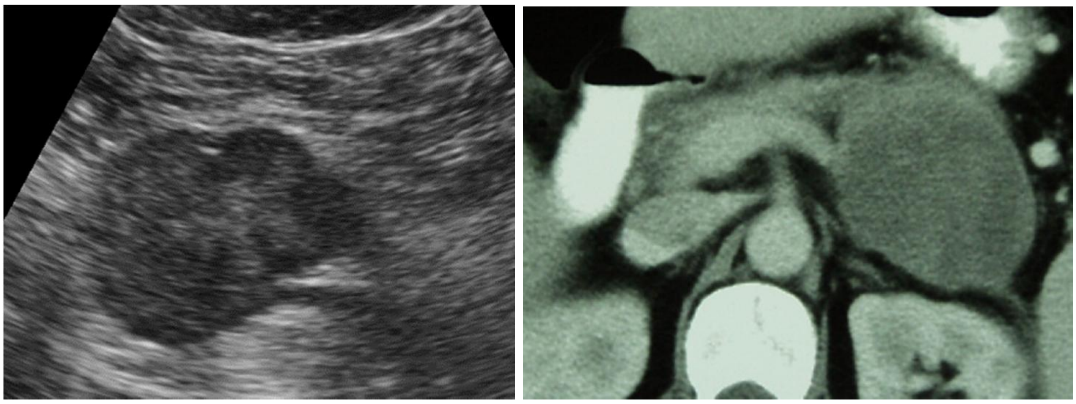


Fig. 4.6.15 Neuroendocrine tumour, UAS transverse

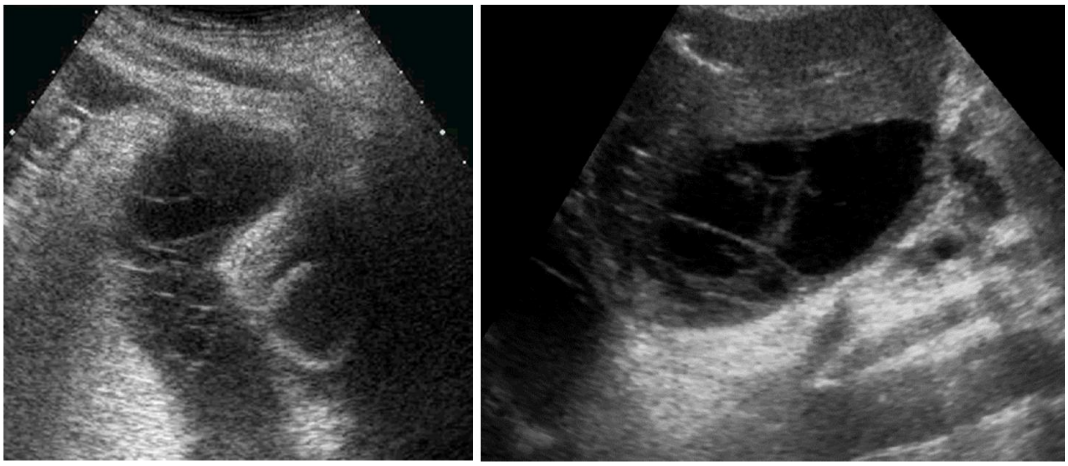


Fig. 4.6.16 a, b "Spider web clot" in ascites of acute pancreatitis (clinical severe progression) in Morison's pouch, somewhat swollen small intestinal loop; FS right

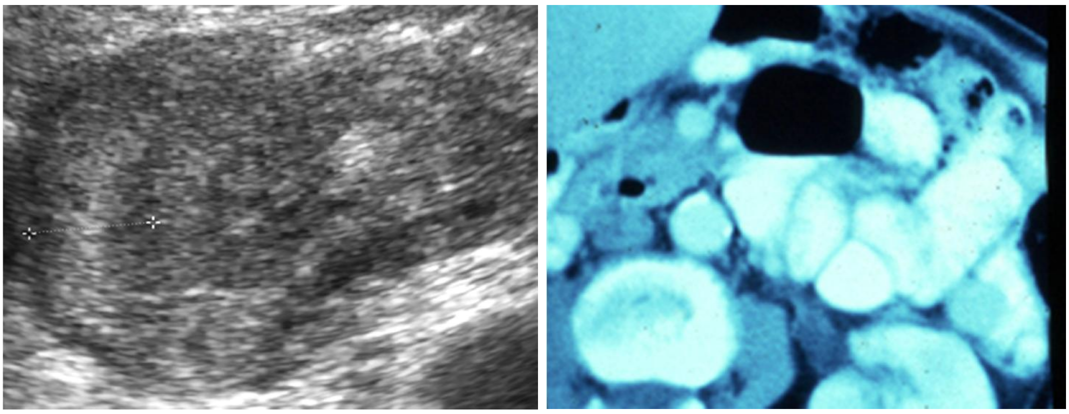


Fig. 4.6.17 Chronic head pancreatitis (alcohol toxicity), swollen duodenum (measurement crosses mark the outer and pancreas-sided contour of the duodenal C); UAS transverse (a)

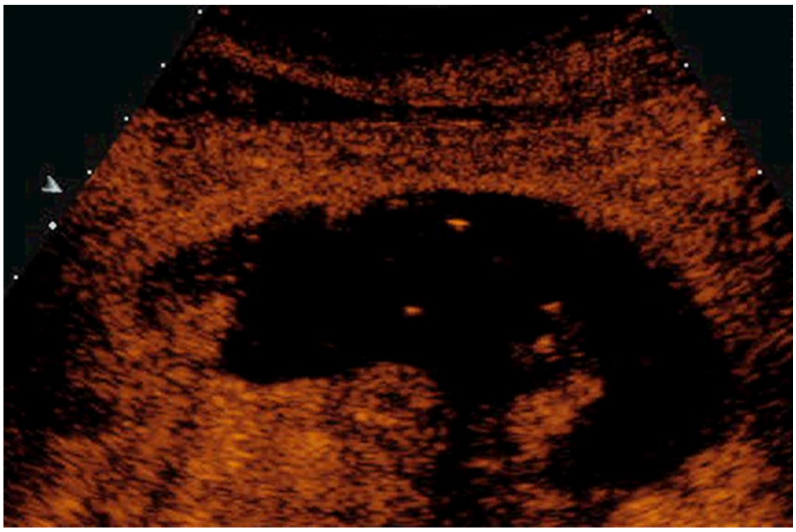


Fig. 4.6.18 Almost completely necrotic pancreas with lacking perfusion in lithogenic pancreatitis (with the exception of the head region, see below) (clinical moderately severe progression, later insulin-dependent diabetes); UAS transverse (with CM)

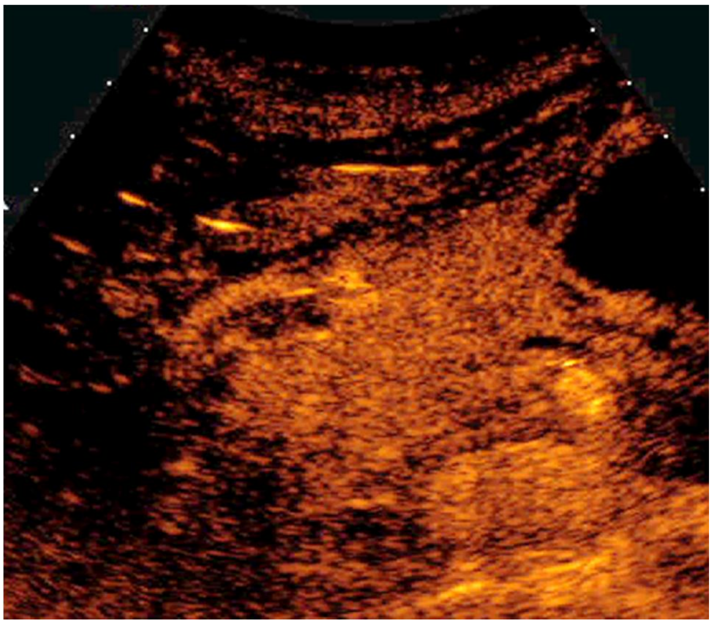


Fig. 4.6.19 Detailed CM study of the preserved pancreas head with normal hepatic and gastroduodenal arteries, as well as duodenal C and abdominal aorta, as well as superior mesenteric artery; UAS transverse

Fig. 4.6.20 Chronic calcifying pancreatitis with parenchyma reduction, ascites, liver cirrhosis; UAS longitudinal

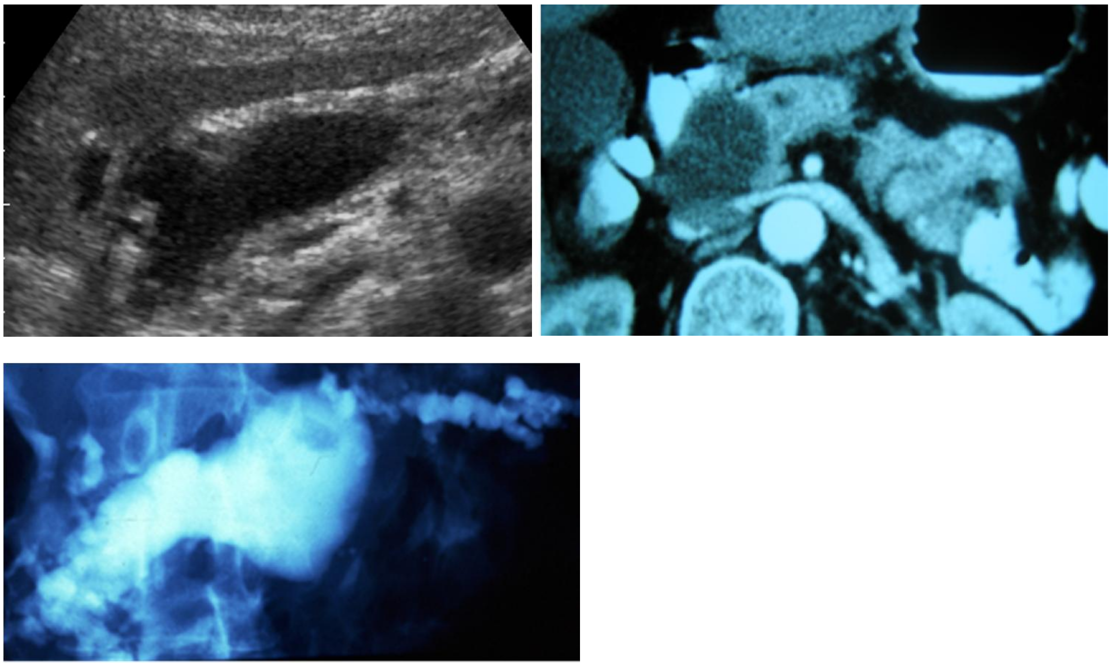


Fig. 4.6.21 a-c Chronic pancreatic duct dilation, no pseudocyst; UAS transverse (a) and ERCP (c)

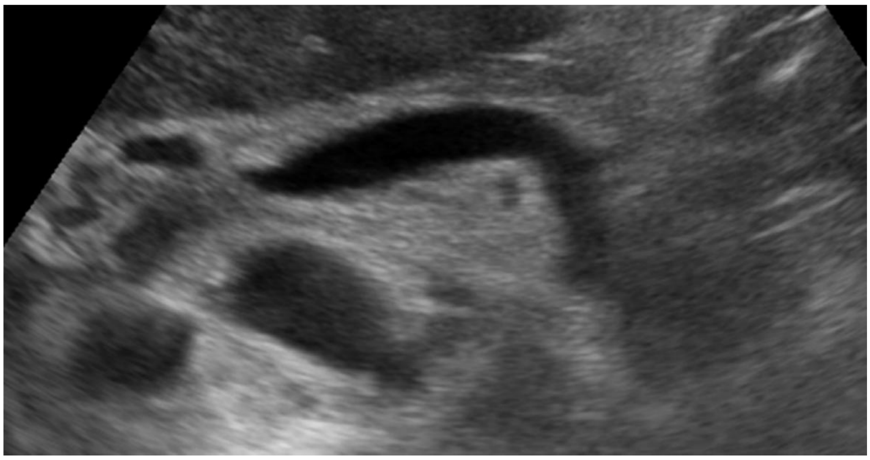


Fig. 4.6.22 Corpus lesion not discovered until check-up sonography; UAS transverse

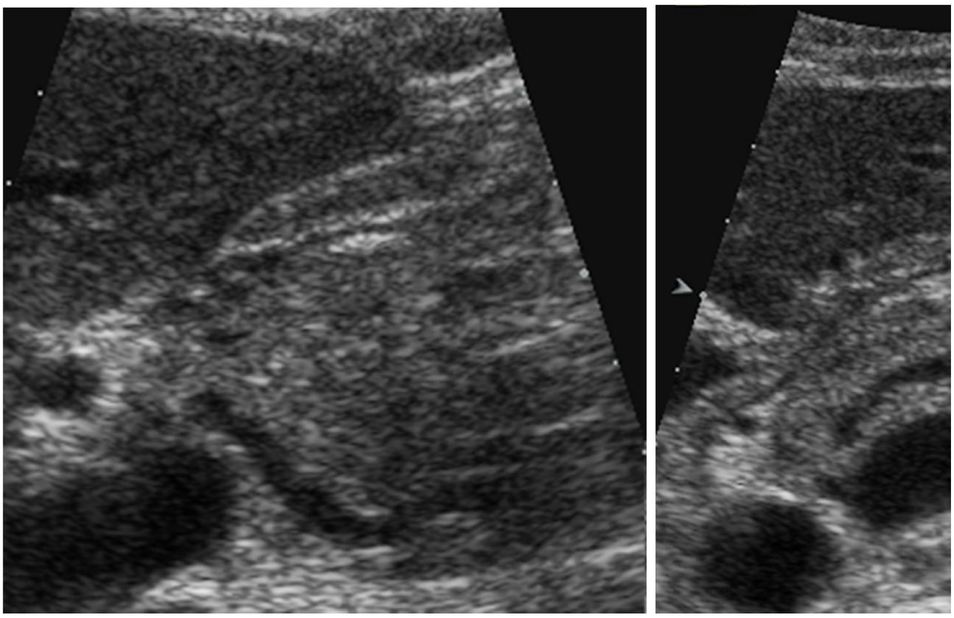


Fig. 4.6.23 a, b Slightly dilated pancreatic duct, traceable directly to prepapillary area (left enlarged image half), normal splenic and portal veins, hepatic and gastroduodenal arteries, as well as (truncated) posterior and anterior antrum wall, duodenum and liver; UAS transverse

The frequently stated superposition of the pancreatic tail area with the gas in the fundus is sometimes cumbersome for the representation of the pancreas and its pathologies.

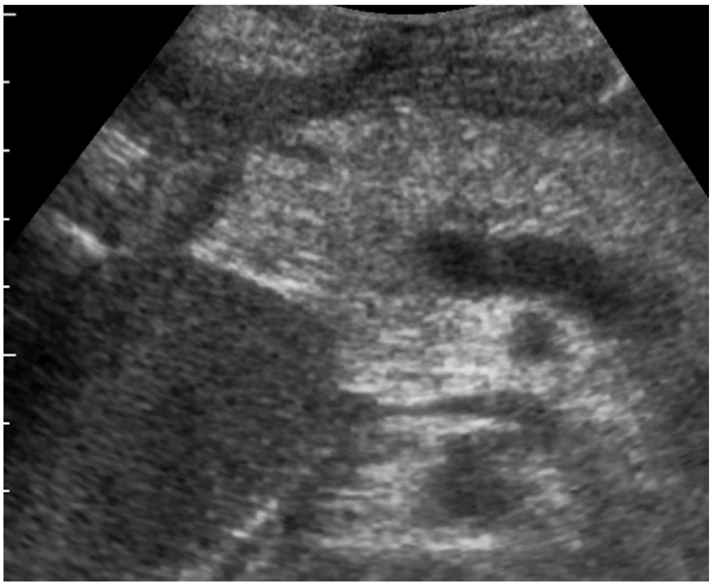


Fig. 4.6.24 After hemi-hepatectomy left atypical wide ventral displacement of pancreas in front of left hepatic lobe, UAS transverse

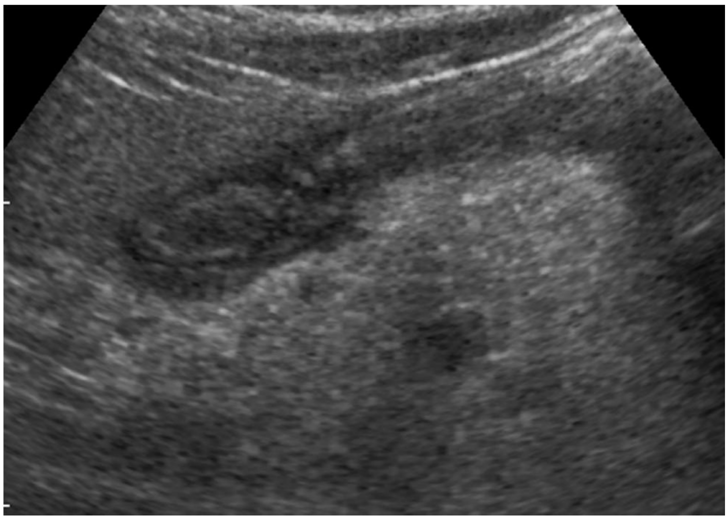


Fig. 4.6.25 Subsiding acute pancreatitis according to clinical criteria; UAS transverse

Fig. 4.6.26   Normal upper abdominal longitudinal sections with pancreas, splenic vein, as well as pancreatic duct and lateral hepatic artery, gastric antrum truncated sections; UAS longitudinal

In any case, the clinical situation is decisive: There are horridly looking pictures with relatively bland clinical outcomes. Vice versa, the pancreas may appear relatively normal in images with clinically severe outcome, up to a seemingly normal pancreas finding in a bout of acute pancreatitis.

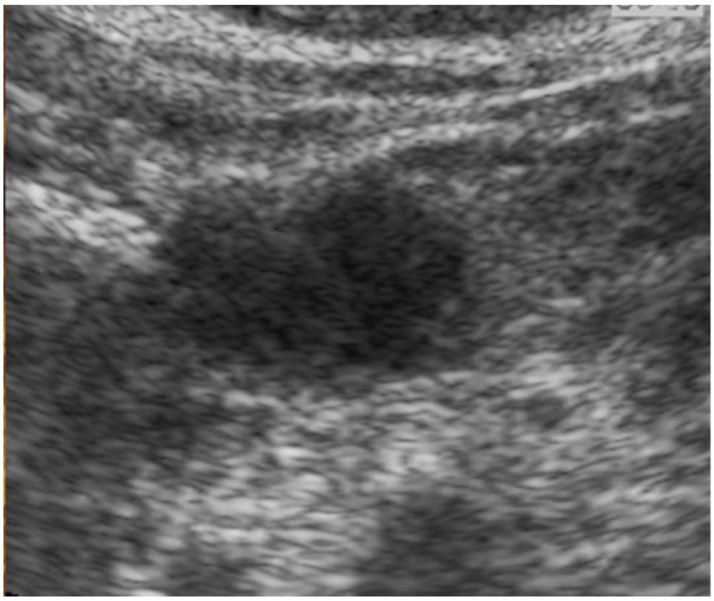


Fig. 4.6.27   Small pancreas head tumour, normal abdominal aorta and inferior vena cava during inspiration; UAS transverse

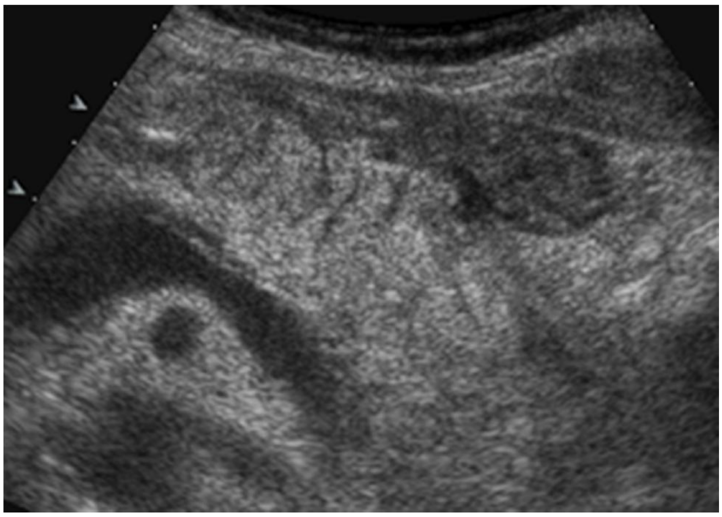


Fig. 4.6.28 Very early clinical stage (hours) of acute pancreatitis, normal splenic and left renal veins, as well as superior mesenteric artery and aorta plus antrum; FS left

Fig. 4.6.29 “Spider web clot“ in pancreatic effusion of right Morrison pouch (clinically severe progression); SCS right

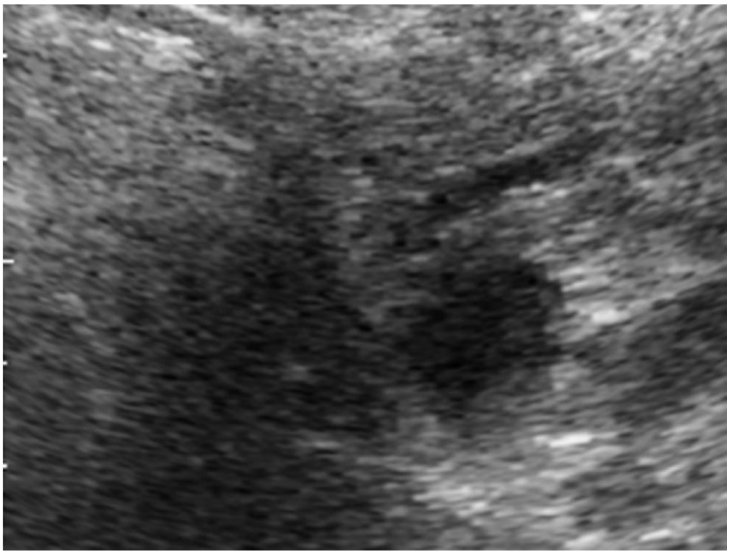


Fig. 4.6.30 Pancreas head tumour with typical poor delimitation and moderately congested pancreatic duct, UAS transverse

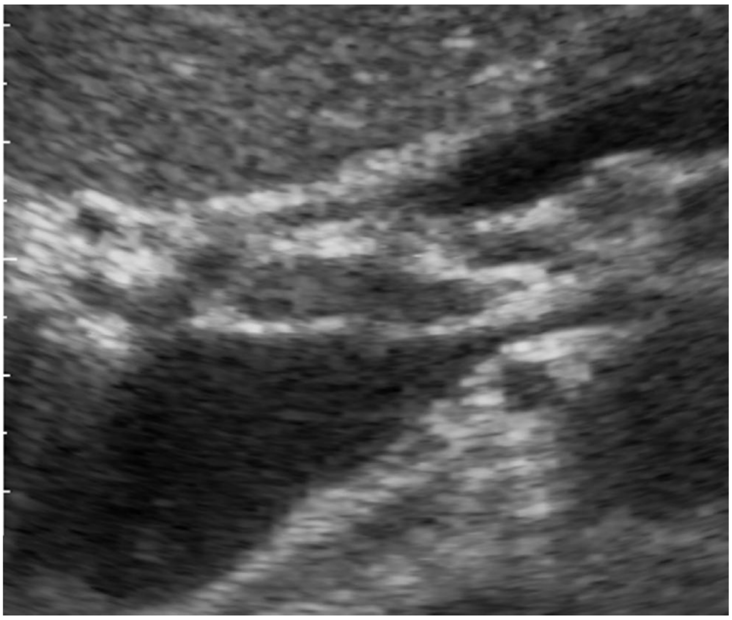


Fig. 4.6.31 Lymphadenopathy of unclear genesis near pancreas head (check-up necessary after e.g. three months); UAS transverse

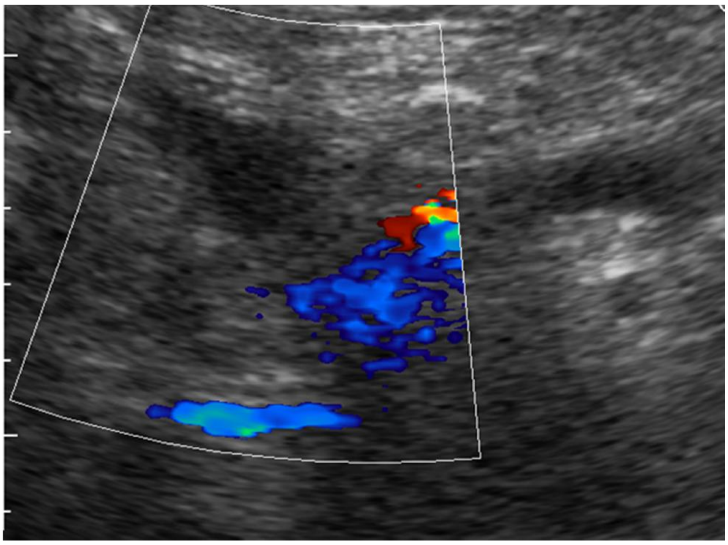


Fig. 4.6.32 Pancreas head tumour; UAS transverse

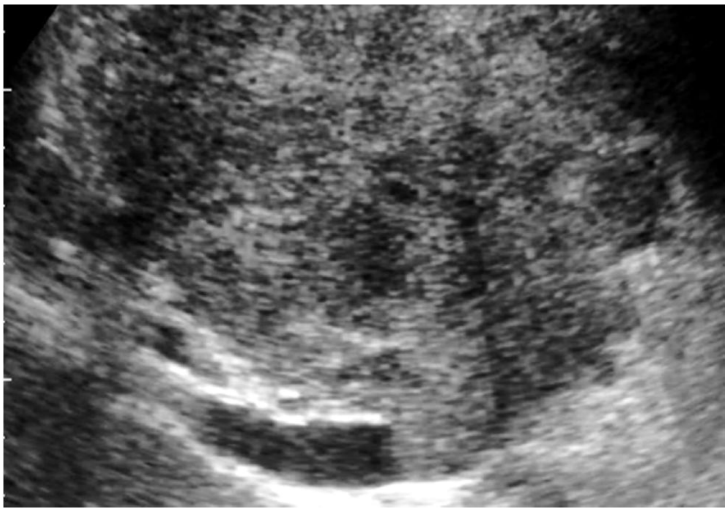


Fig. 4.6.33 Portal lymph node metastasis of a colorectal carcinoma with portal vessel invasion and compression of hepatic bile duct and unaffected interjacent hepatic artery; UAS transverse

Fig. 4.6.34 Large pancreatic tail tumour; FS left

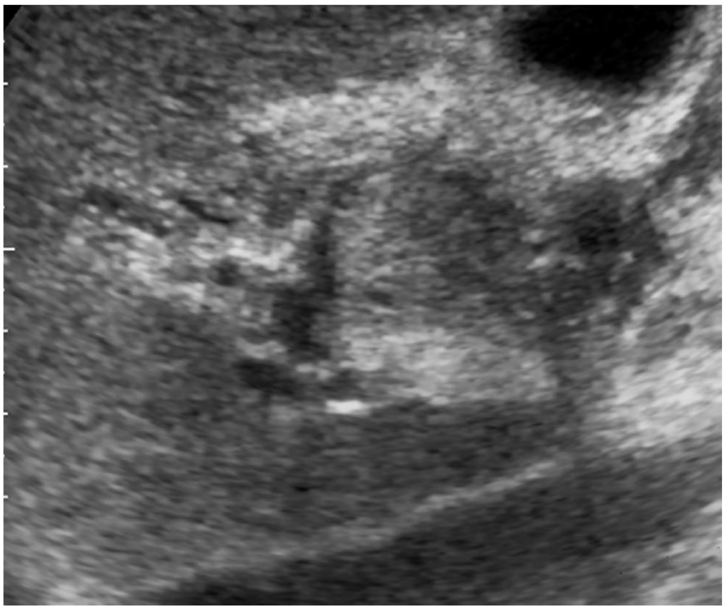


Fig. 4.6.35 Portal vein thrombosis; FS right

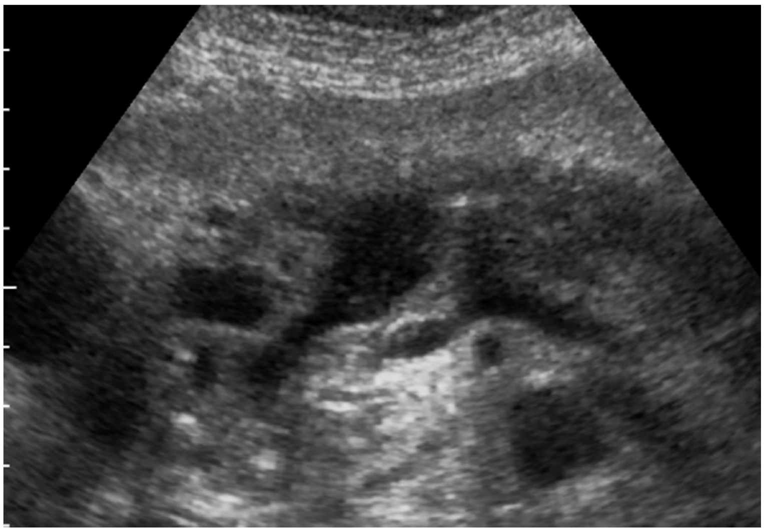


Fig. 4.6.36 Fresh pseudocysts; UAS transverse

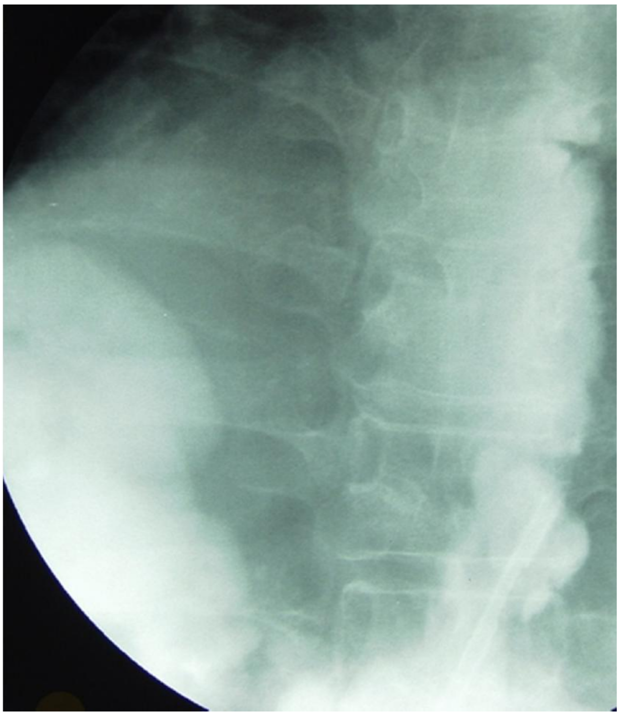


Fig. 4.6.37 Pancreatic pleural fistula in ERCP

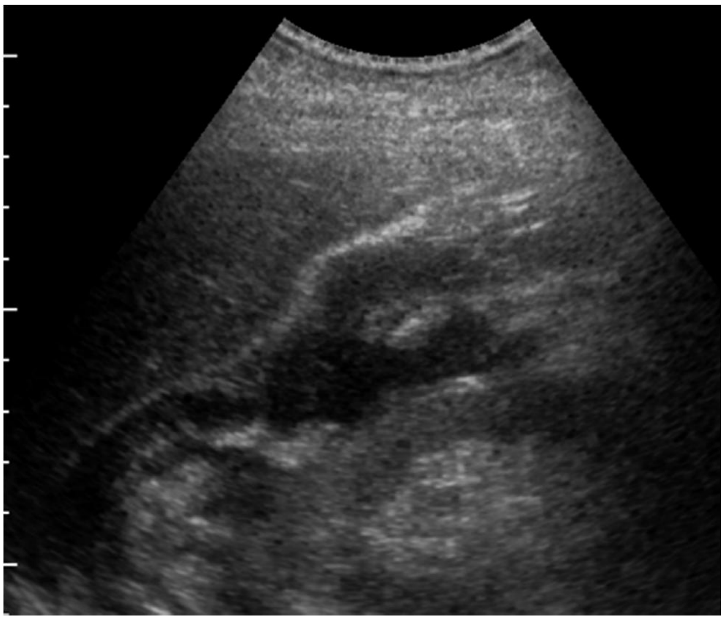


Fig. 4.6.38 Effusion in omental bursa and Morison's pouch; UAS transverse

Fig. 4.6.39 Malign lymphoma close to the pancreas head; UAS transverse

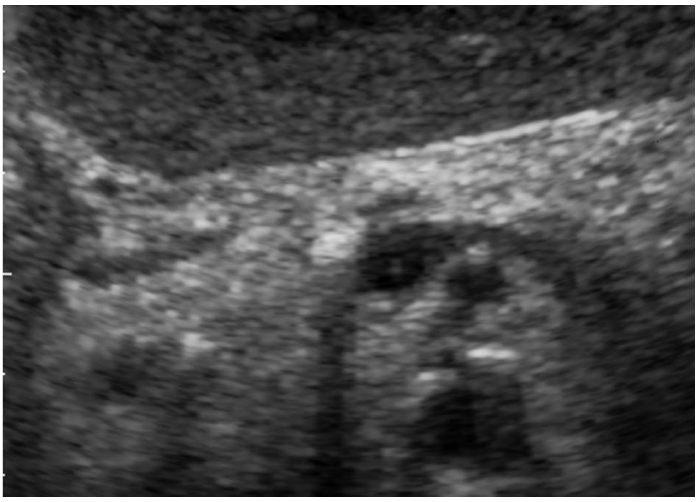


Fig. 4.6.40 Pancreatic lithiasis; UAS transverse

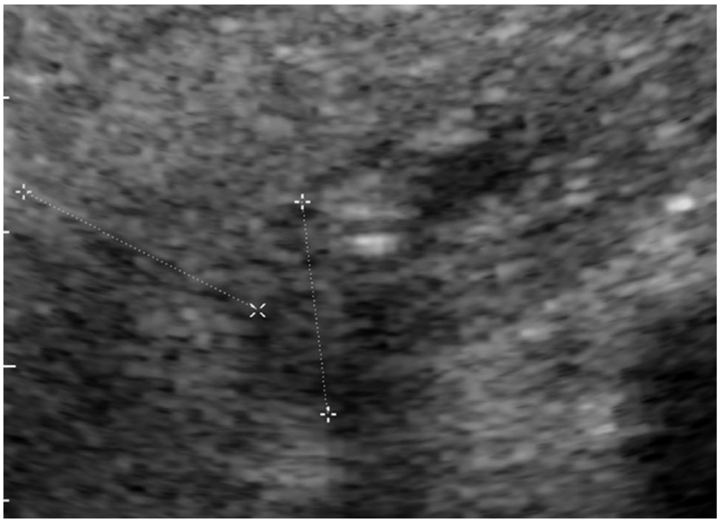


Fig. 4.6.41 Papillary tumour (right measurement cross) with congestion of pancreatic duct and stent in hepatic bile duct; UAS transverse

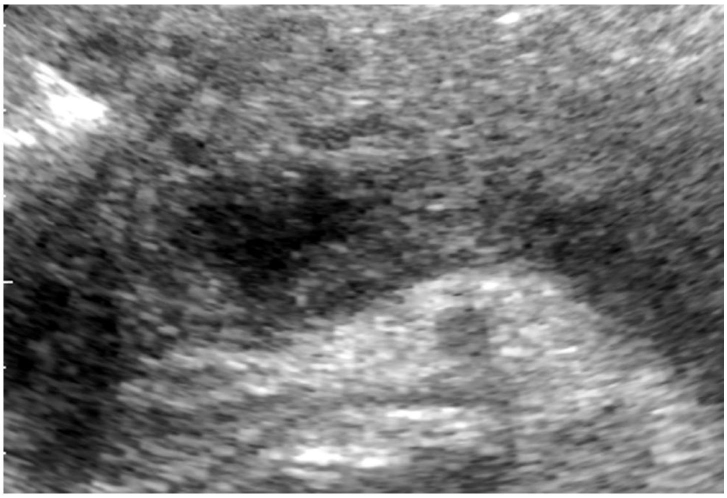


Fig. 4.6.42 Fresh pseudocyst; UAS transverse

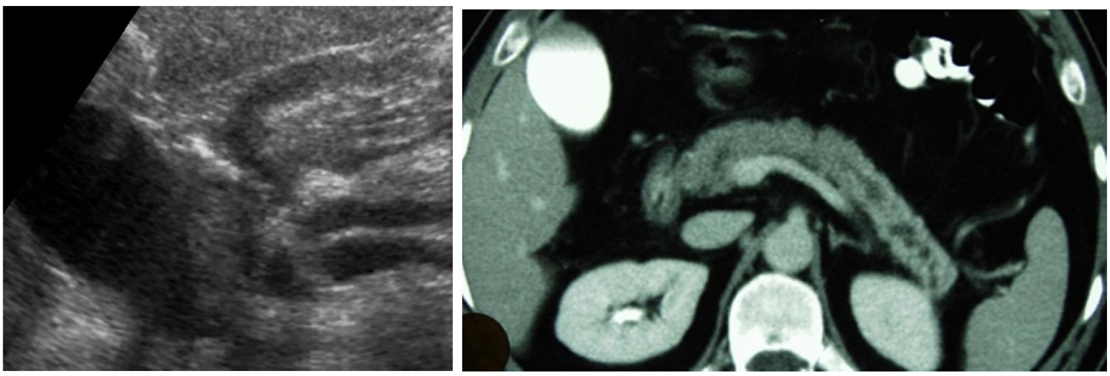


Fig. 4.6.43 a, b Chronic pancreatitis; UAS transverse (a)

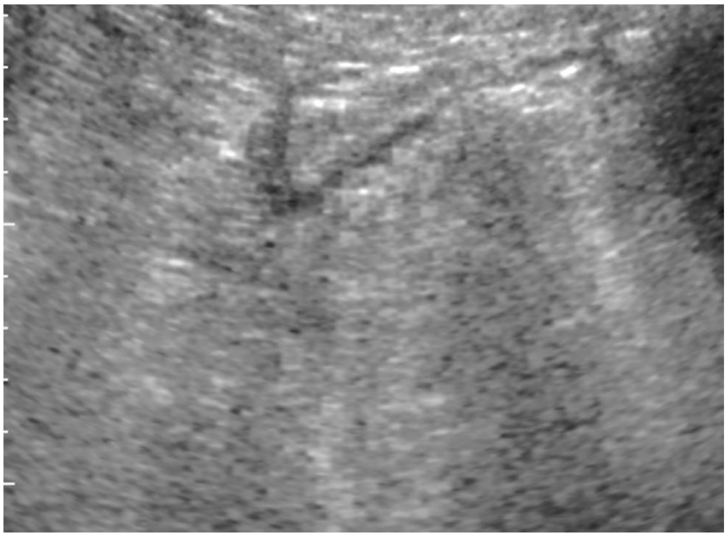


Fig. 4.6.44 Acute oedematous pancreatitis; UAS transverse

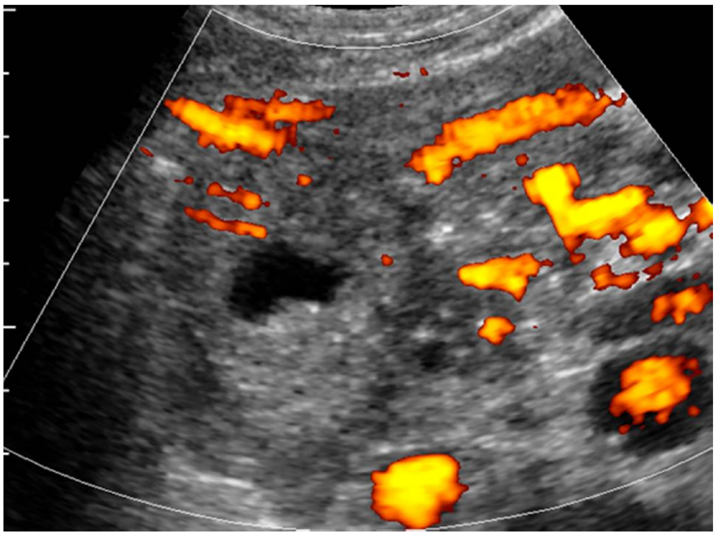


Fig. 4.6.45 Fresh pseudocyst; UAS transverse with CCDS

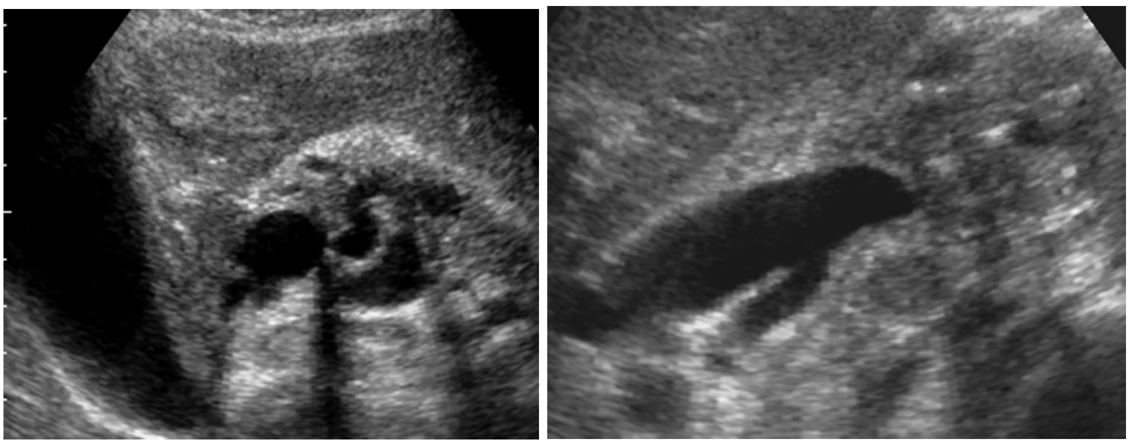


Fig. 4.6.46 a, b Small prepapillary pancreas head tumour with biductal stenosis and dilatation; UAS transverse

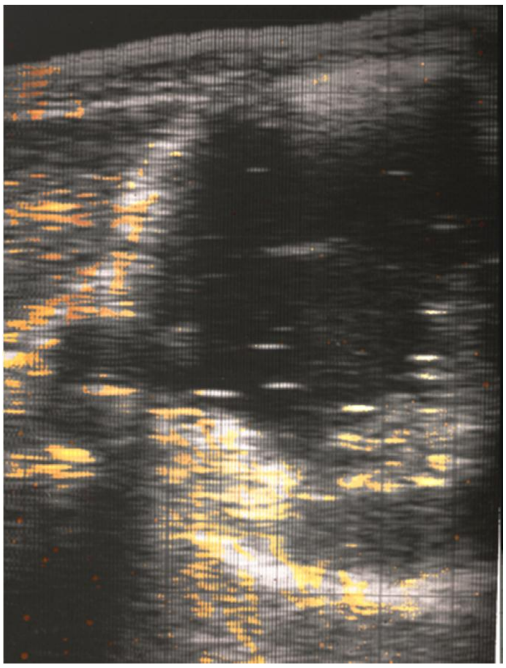


Fig. 4.6.47 Large pseudocyst with spontaneous regression during follow-up over the years; UAS longitudinal

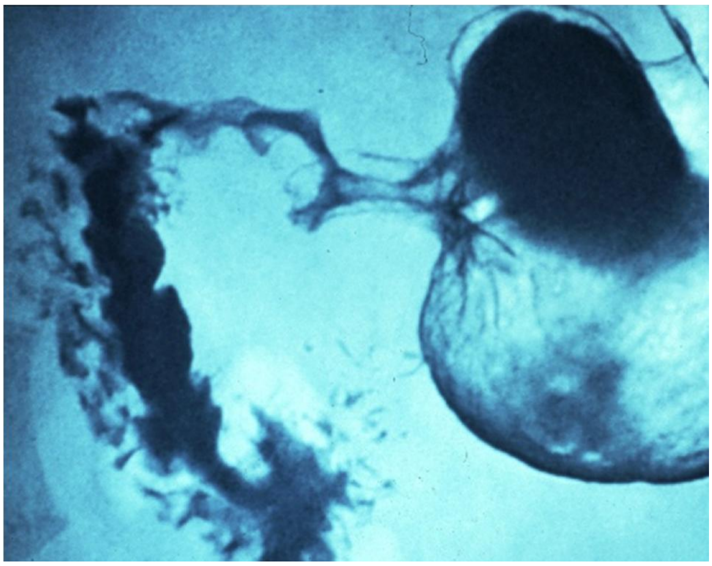


Fig. 4.6.48 Pancreas head cancer with duodenal invasion ("Frostberg's sign")

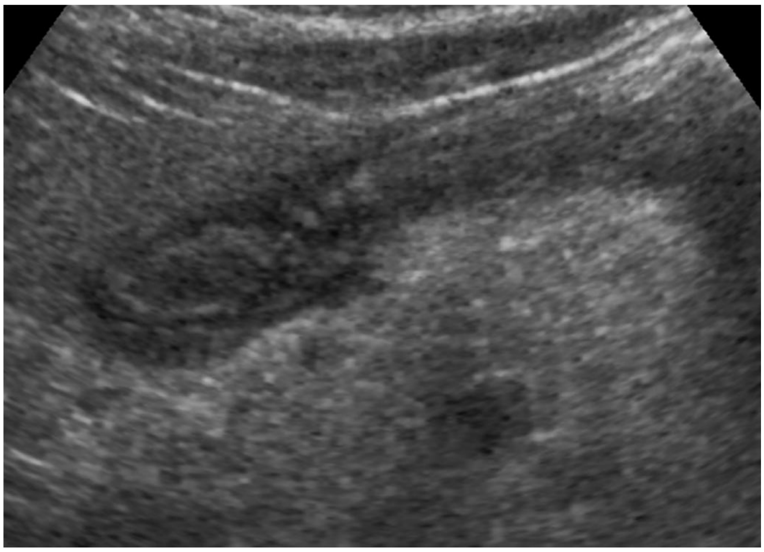


Fig. 4.6.49 oedematous acute pancreatitis ; UAS transverse

Fig. 4.6.50 Chronic pancreatitis; UAS transverse

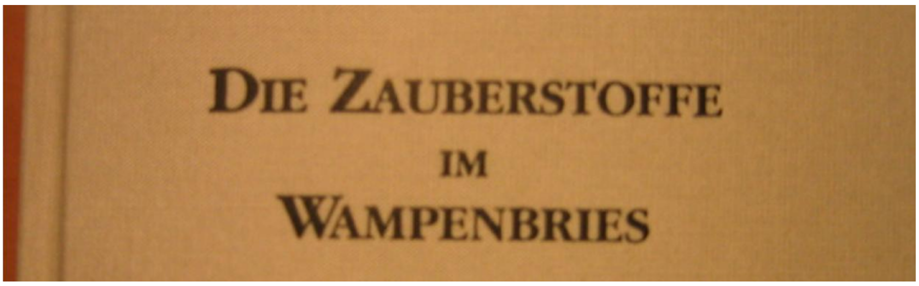


Fig. 4.6.51 Old publication: “Magic substances in the abdominal gland“ (The story of the research on the exocrine pancreas and the active substance pancreatin)

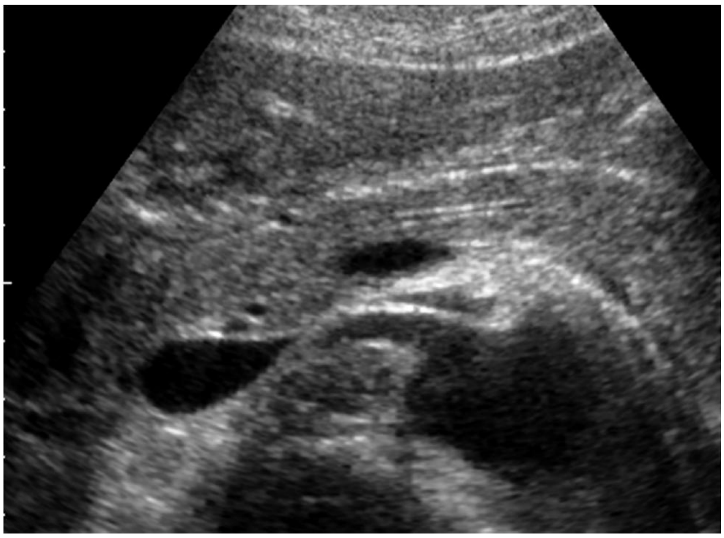


Fig. 4.6.52   Normal transverse UAS, left renal vein congested ("Nutcracker syndrome")

Fig. 4.6.53   Lymphomas bordering inconspicuous pancreas head (clinical sarcoidosis); UAS transverse

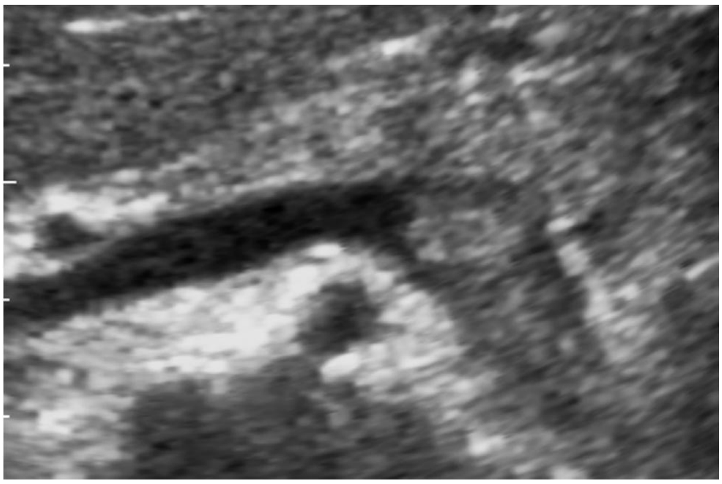


Fig. 4.6.54 Splenic vein thrombosis with acute pancreatitis; UAS transverse

Please note:

- **pancreas sonography is seen (wrongly?) as the high art of sonography**
- **correlate clinical picture**
- **use also unusual section patterns**
- **position cross-sections high (sub-xiphoidal) in deep inspiration**
- **appreciate tail and corpus region, possibly CT**
- **take spontaneous and surveying elastography into account**

4.7 Kidneys

Fig.4.7.01 Urine retention of the 1st degree, nephrolithiasis; FS right

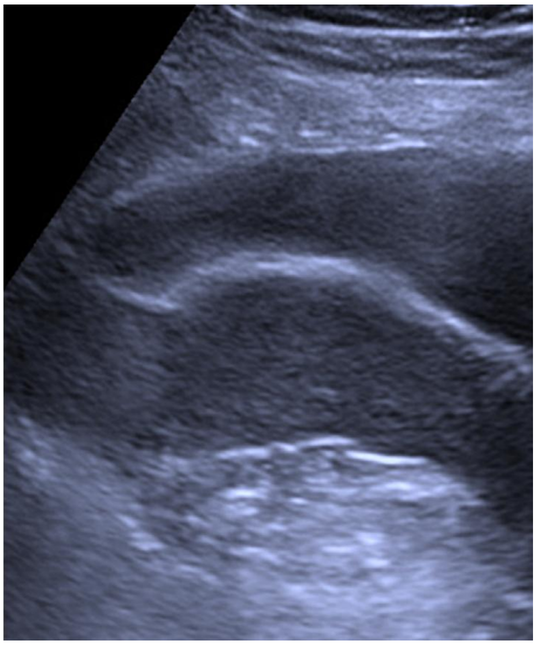


Fig.4.7.02 Atrophic kidney left; FS left

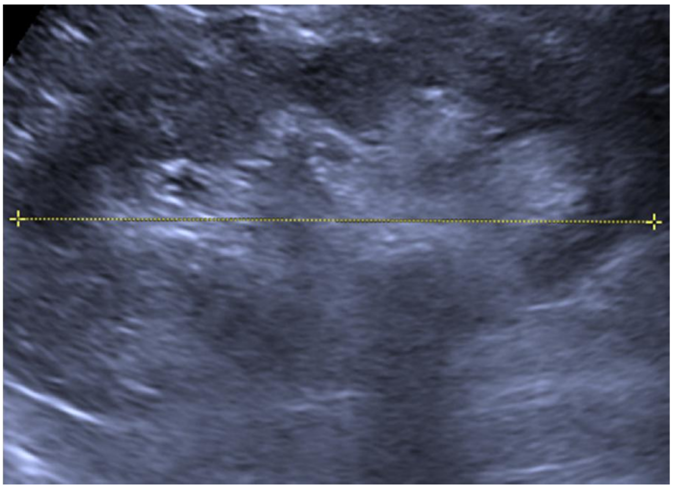


Fig. 4.7.03 Difficult nephrolithiasis; FS right

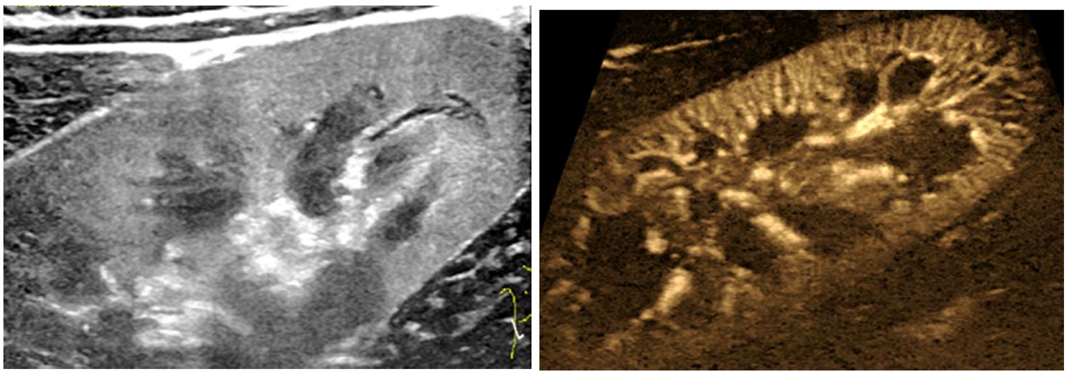


Fig.4.7.04 a, b Image of normal right kidney in current technology; FS right (with CM vessel imaging b)

The kidneys and urinary tract must be comprehensively examined on both sides, at least during the first sonography. Discovery of thus far asymptomatic renal and urinary tract tumours, which can then still be cured or (even partially) resected, belongs to the paramount tasks of screening sonography. Often small peripherally located hidden tumours or small tumours of the urinary tract require special attention.

The kidneys seem to have been made just for sonography, not without reason it was the urologists (after the gynaecologists), who were the first to administer clinical sonography to their needs.

Since kidney diseases occur frequently and are often accompanied by macro-pathologically recognizable changes, sonography is an indispensable diagnostic tool for these essential organs. Still by far too many intravenous pyelograms and CT examinations are being arranged.

Thus the wording "low dose CT" sounds good, but is equivalent to the i.v. pyelogram with respect to radiation exposure. It is to be kept in mind that despite technical progress, the total radiation exposure from unnatural sources, i.e. primarily as a consequence of CT examinations, is still increasing.

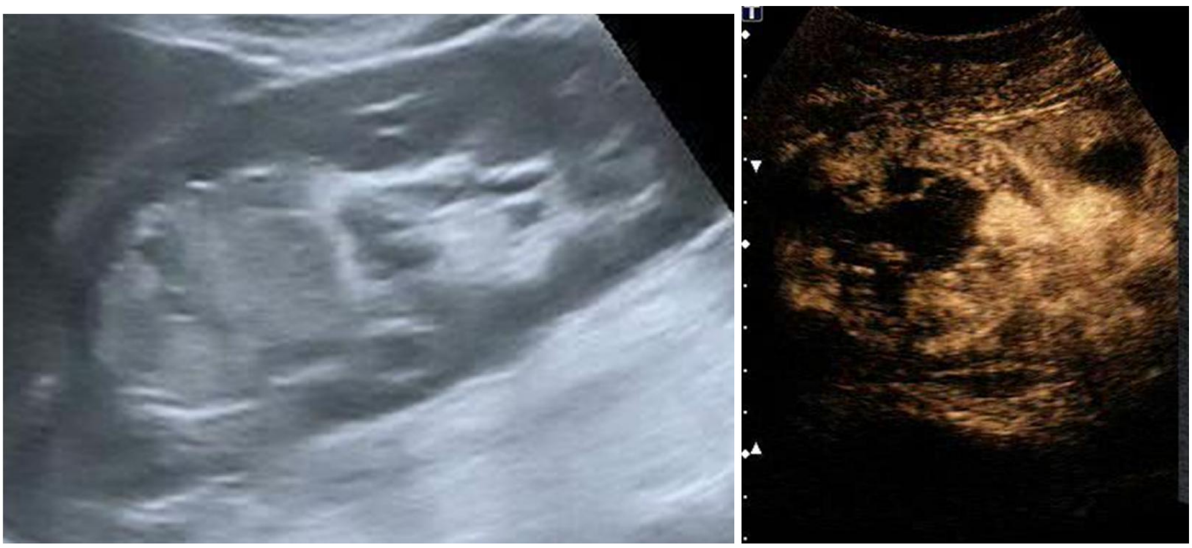


Fig.4.7.05 a, b Renal pelvis malignoma; FS right (b with CM)

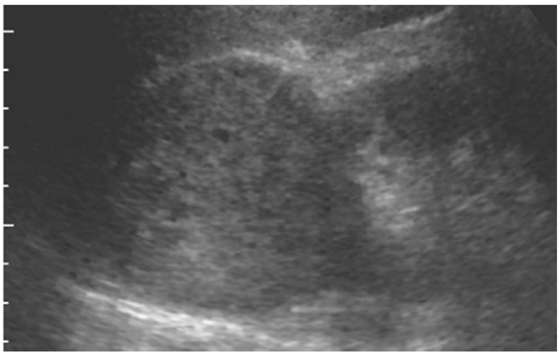
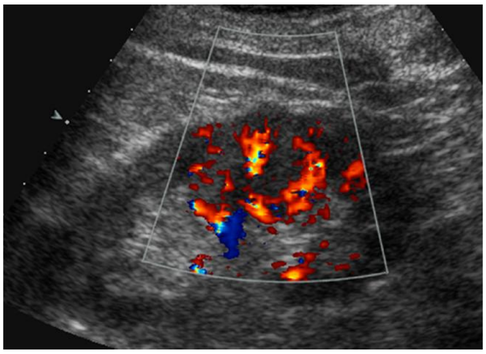



Fig.4.7.06 a, b Asymptomatic renal tumours in two different cases; FS right (with partially substantial perfusion in CCDS (a)), and pathological vessels (b)

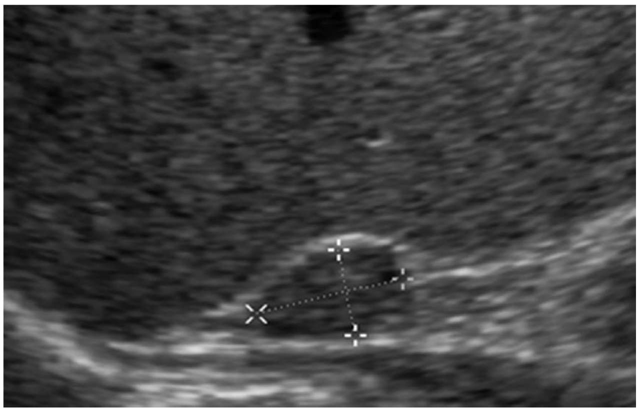



Fig.4.7.07 a, b Incidentaloma (left image half) and partly cystic tumour; FS (two different cases)

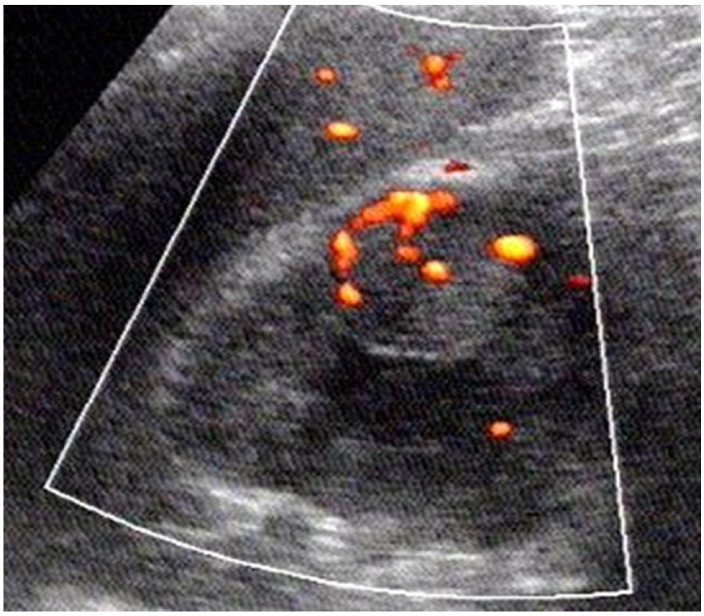


Fig. 4.7.08 Lymphoma infestation of the right kidney; FS right

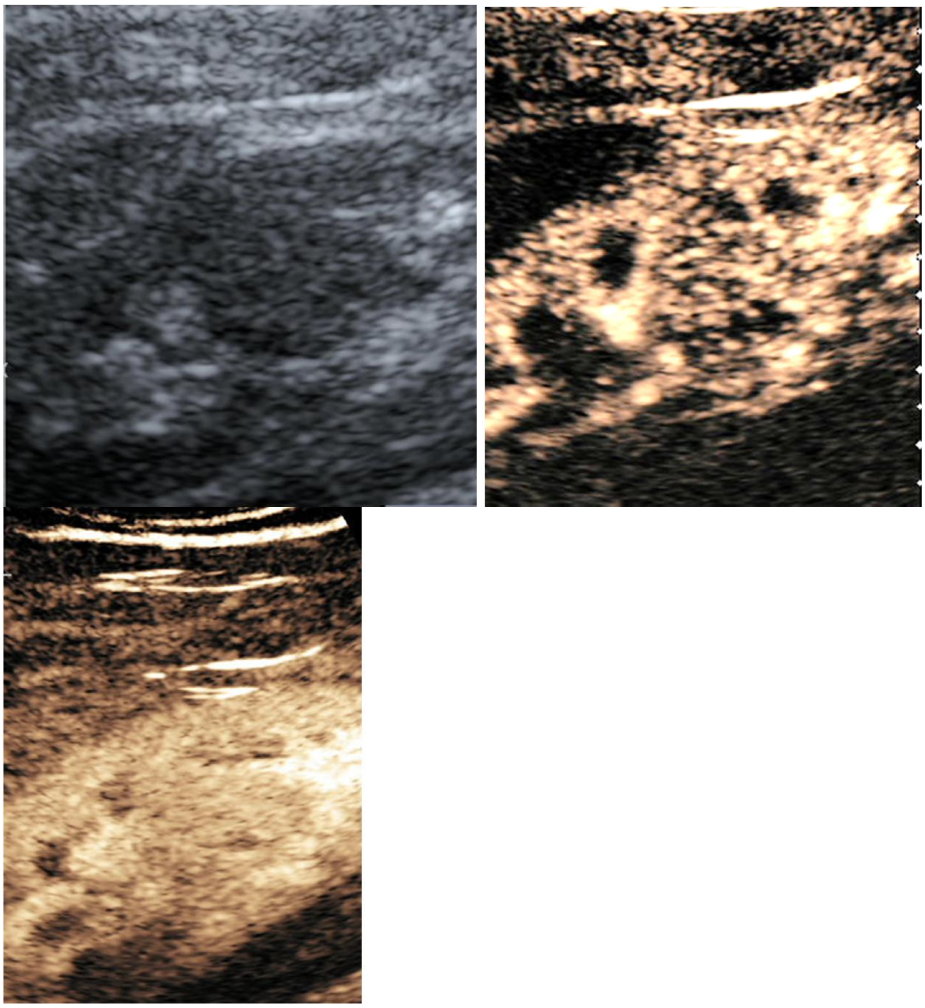


Fig.4.7.09 a-c Prominent renal column of left kidney; FS right (b and c respectively each with CM in early and intermediate filling phase)

Fig.4.7.10 Lymph node metastases of (clinically proven) prostate cancer with ureter congestion; FS right

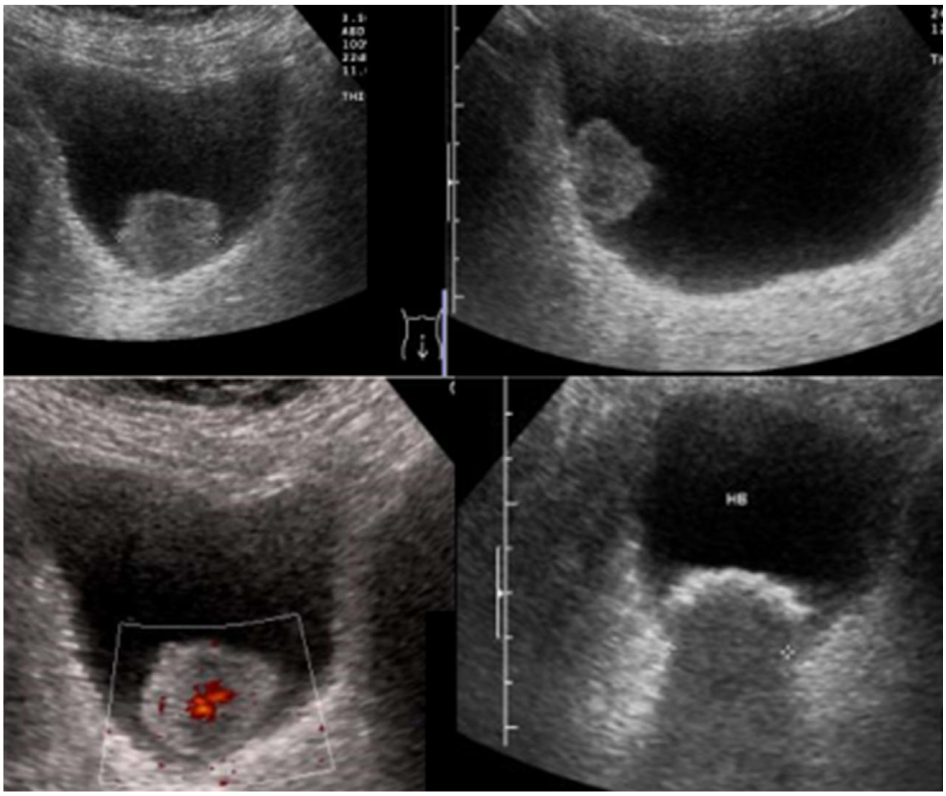


Fig. 4.7.11 a-d Stationary (even during positioning constant) asymptomatic urinary bladder tumour, and for comparison another case with urinary calculi and acoustic shadow (d); LAS (c CCDS)

Possible causes for a dilated ureter are to be equally thoroughly clarified as all possible pathologies of the small pelvis; it is particularly suited for small amounts of ascites, the proof of which is sometimes only successful when sitting.

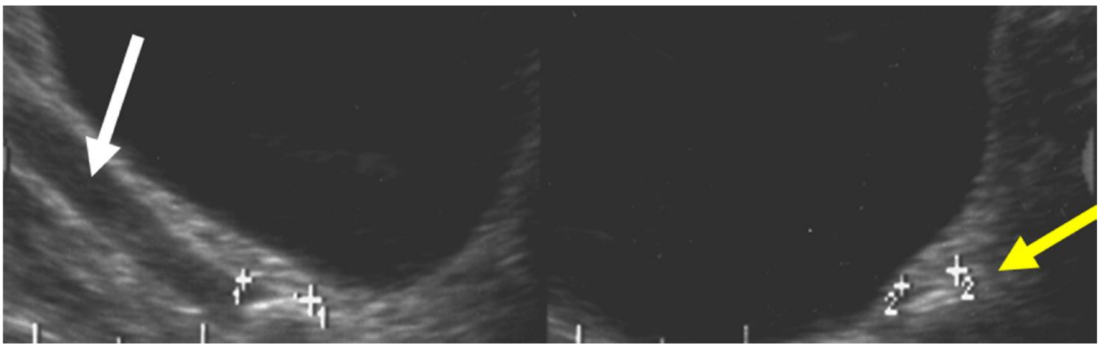


Fig.4.7.12 a, b Dilated ureter (white arrow) from symptomatic calculus (yellow arrow); LAS longitudinal and transverse (a and b)

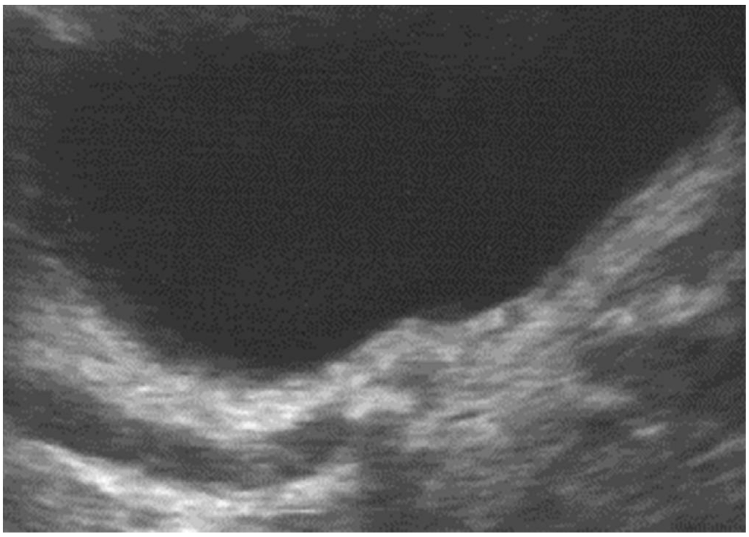


Fig.4.7.13 Symptomatic ureter calculus, congested ureter; LAS longitudinal

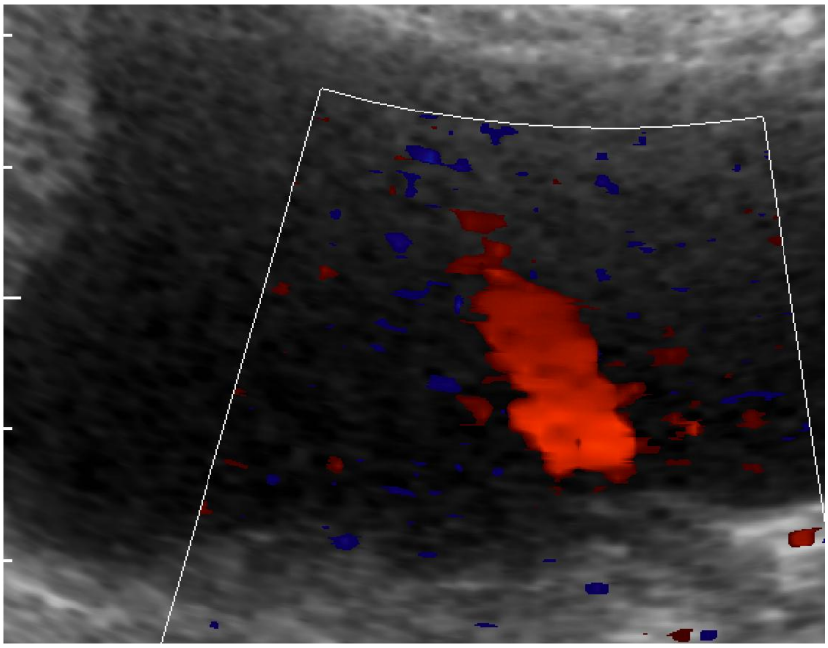


Fig. 4.7.14 Jet phenomenon of a ureter; LAS longitudinal

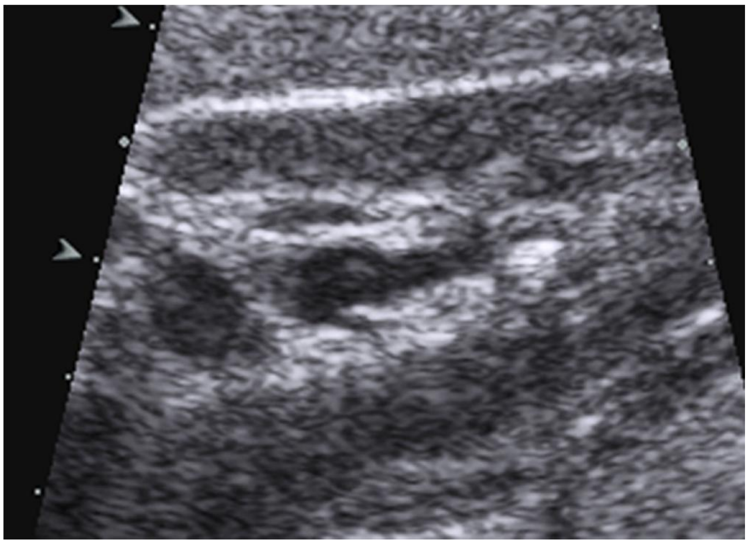


Fig.4.7.15 Asymptomatic nephrolithiasis, easily overlooked in typical fashion with little surrounding fluid (in contrast to gall stones); FS right

Fig.4.7.16 Haemangiomyolipoma; FS right

Equally, organs of the large and small pelvis have to be observed in case frequent normal variations are present. Post-surgical conditions, such as denervated and pseudo-dilated states after kidney transplantation, have to be paid attention to, also the almost always innocuous renal cysts and haemangiomyolipomas, even in their no longer harmless differential diagnosis.

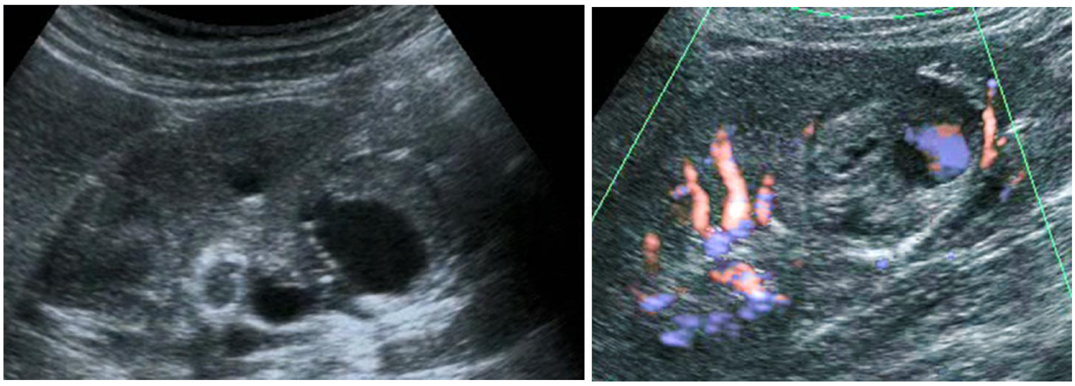


Fig.4.7.17 a, b Renal artery aneurysm; FS left (b with CCDS)

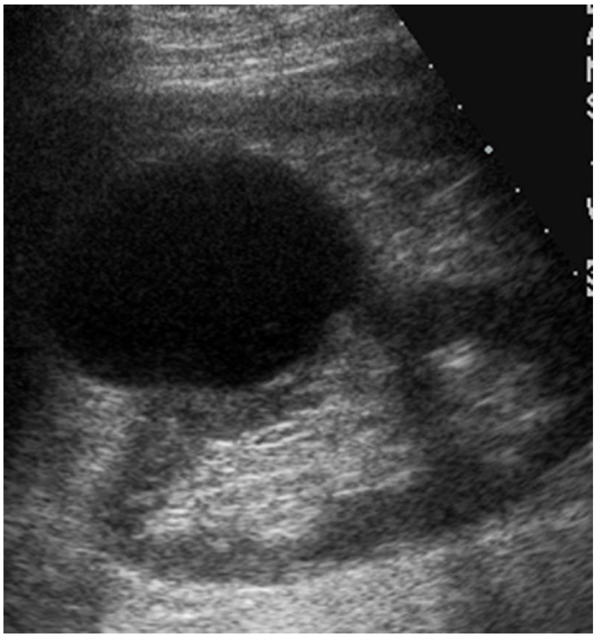


Fig.4.7.18 Renal cysts; FS left

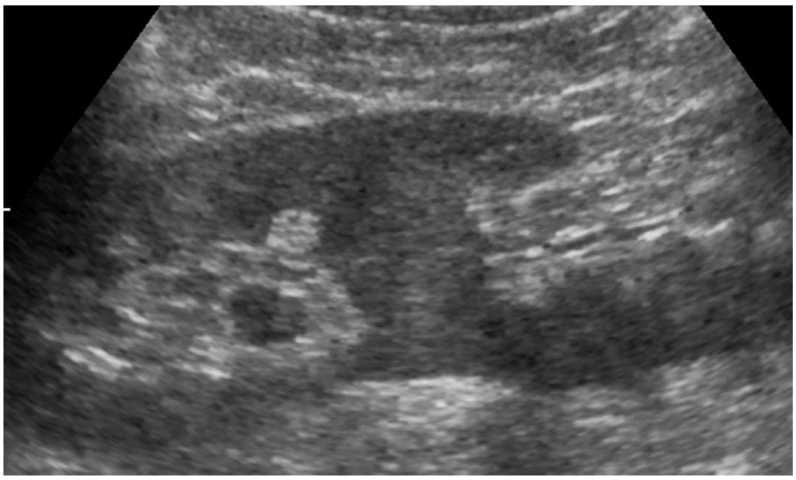


Fig.4.7.19 Parenchymal bridge as normal variation, additionally incomplete lower kidney pole, small focal lesions meaning small haemangiomyolipoma; FS right

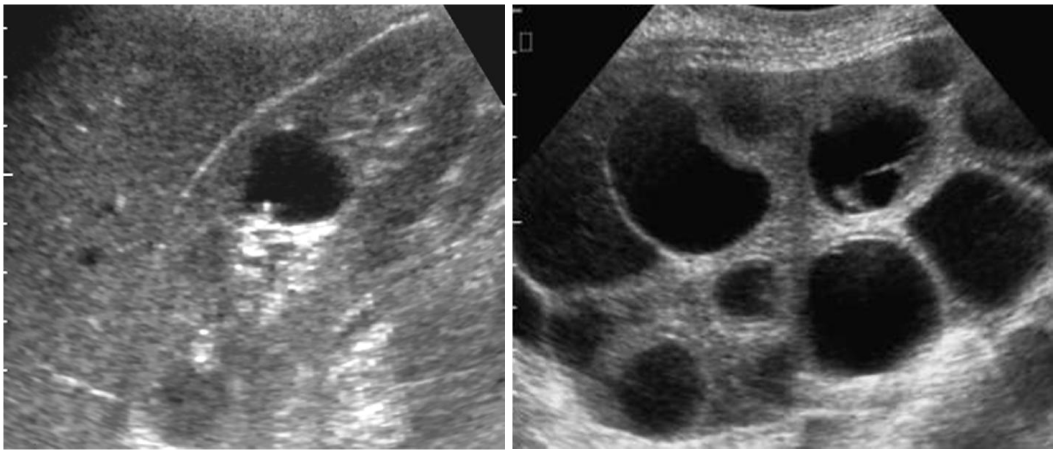


Fig.4.7.20 a, b Asymptomatic renal cysts (a) and cystic kidneys (different cases); FS right

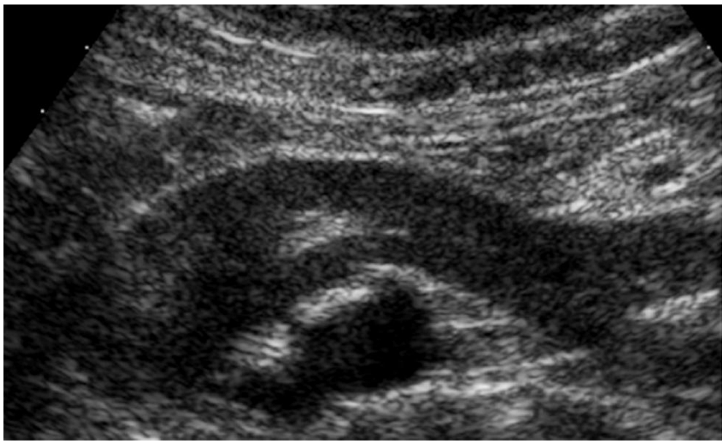


Fig.4.7.21 Horseshoe kidney, no lymphadenopathy; LAS transverse

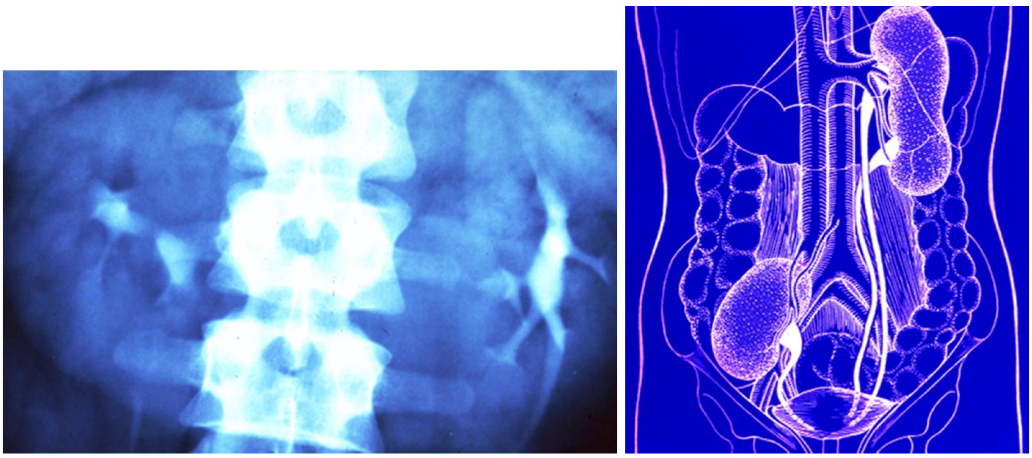


Fig.4.7.22 a, b X-ray picture of horseshoe kidney and schematic depiction of right renal dystrophy, as well as complete duplex kidney left with duplicated ureter

Fig.4.7.23 Small ureterocele, vagina, and rectum normal; LAS transverse

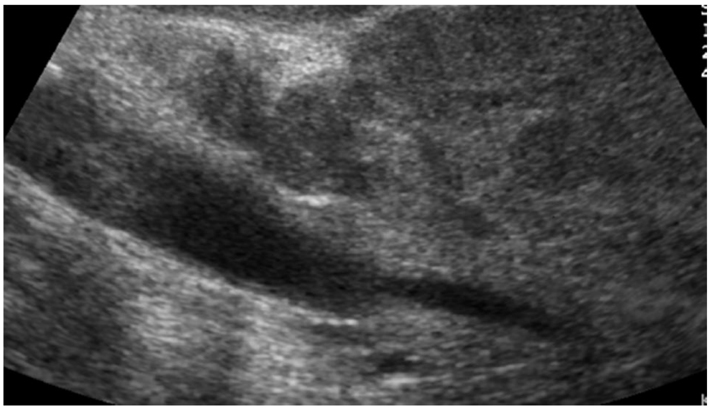


Fig.4.7.24 Obstructive lymphadenopathy of small pelvis; LAS right

Fig.4.7.25 Urine retention first to second degree (of three possible degrees); FS right

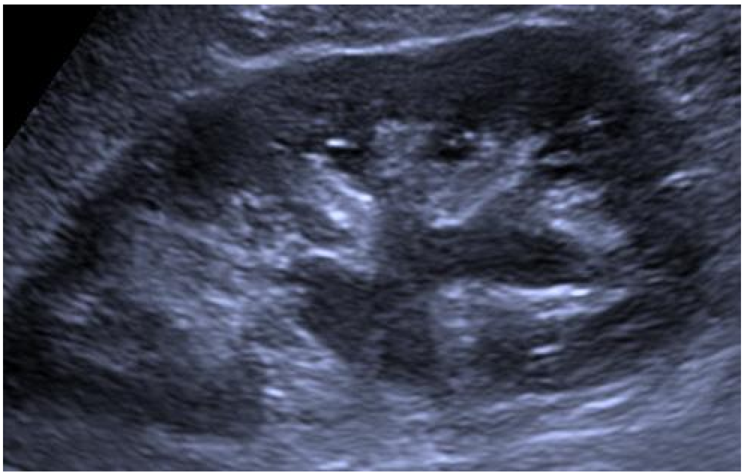


Fig. 4.7.26 Acute urine congestion (1st degree); FS left

Fig.4.7.27 The right kidney is held together (post-traumatic) by a synthetic mesh (surgical insertion); FS right

The kidneys as well as the (urine abundant!) urinary bladder (toilets do not necessarily belong to the sonography ambiance, or should at least be locked) are then easily and thoroughly examined. Occasionally renal tumours exhibit symptoms somewhat late.

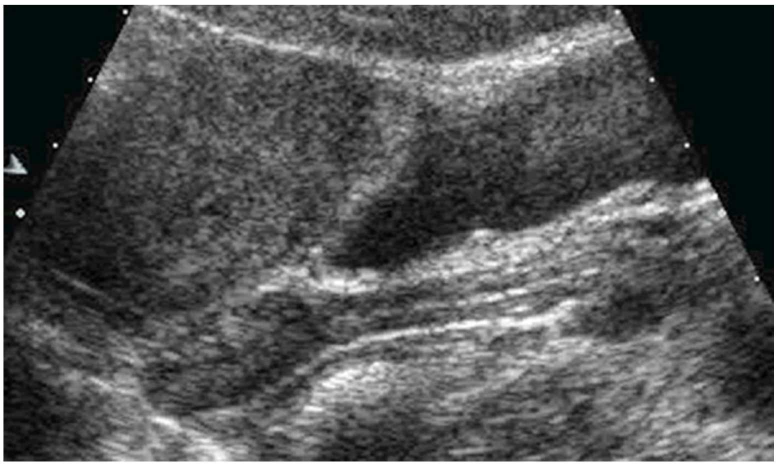


Fig.4.7.28 Normal and still juvenile lower abdominal status (female) with urinary bladder, vagina and uterus, faeces filled rectum; LAS longitudinal

Fig.4.7.29 Normal juvenile lower abdominal status (male) with urinary bladder, prostate, seminal vesicles, and rectum; LAS transverse

Fig.4.7.30 Urinary bladder diverticulum (endoscopically inaccessible!) with atrophied wall; LAS transverse

Fig.4.7.31 Bladder trigone, normal findings also for urethra and (faeces filled) rectum; LAS longitudinal

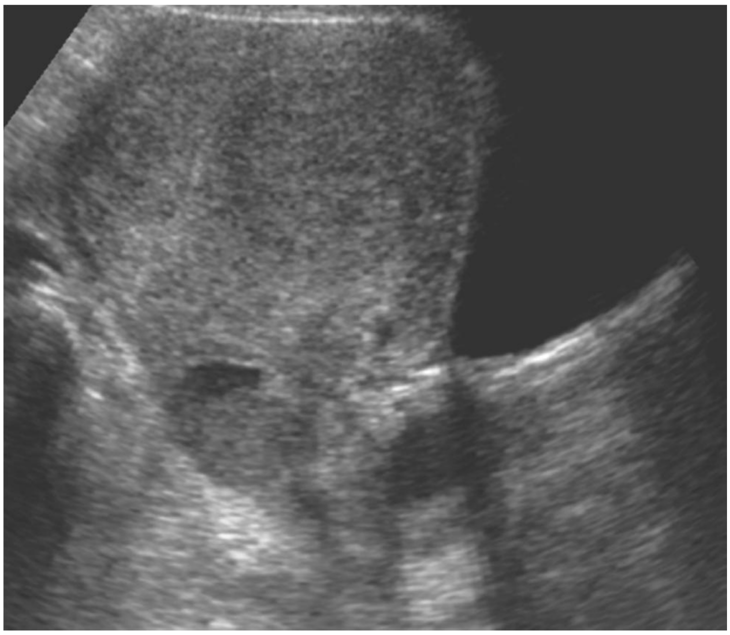


Fig.4.7.32 Uterine fibroids, cystic area of the cervical portio; LAS longitudinal

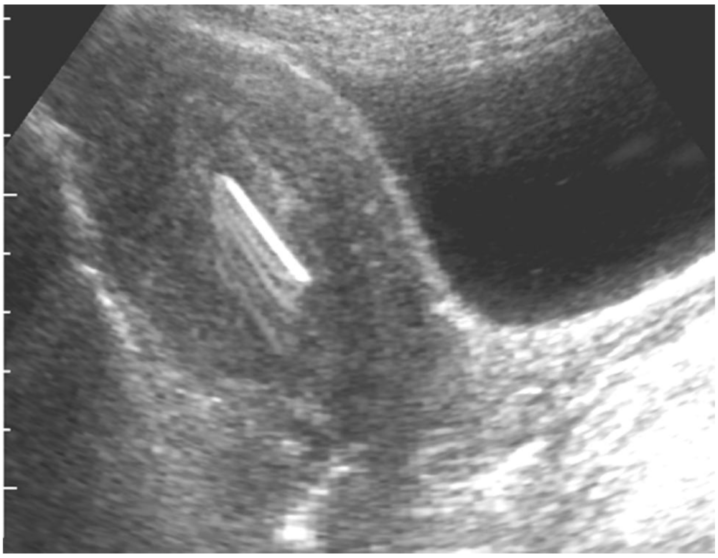


Fig.4.7.33 Intra-uterine pessary (IUP), correctly situated, normal findings for rectum and vagina; LAS longitudinal

Fig.4.7.34 Tumour causing hypertrophy at the bladder trigone, normal rectum; LAS longitudinal

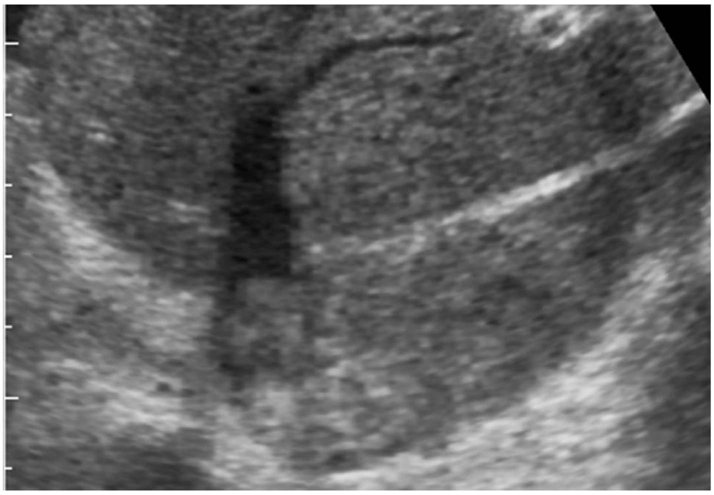


Fig.4.7.35 Tumour thrombosis of inferior vena cava with right-sided renal adenocarcinoma; FS right

Ascites should always be a reason for further clarification (exception: ovulation), most likely by sonography guided puncture.

Fig.4.7.36 Small amounts of ascites, permanent bladder catheter; LAS longitudinal

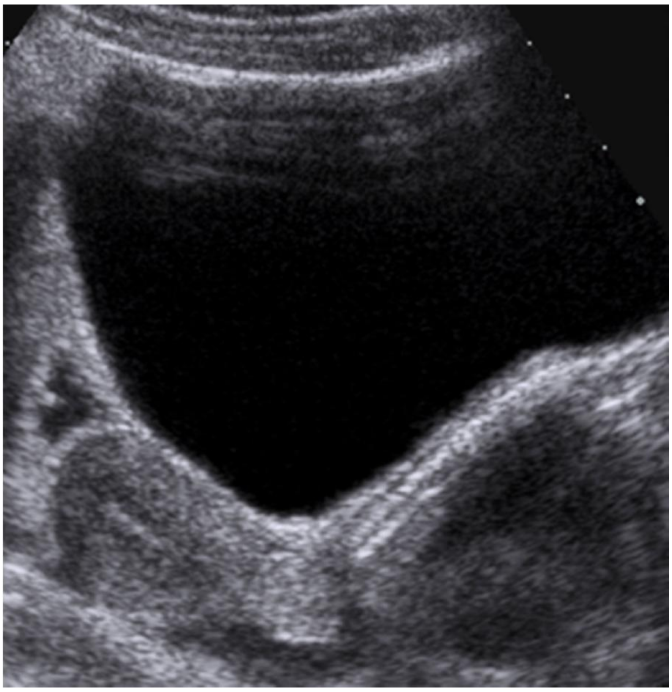


Fig.4.7.37 Minimal amount of ascites during ovulation, otherwise normal findings; LAS longitudinal

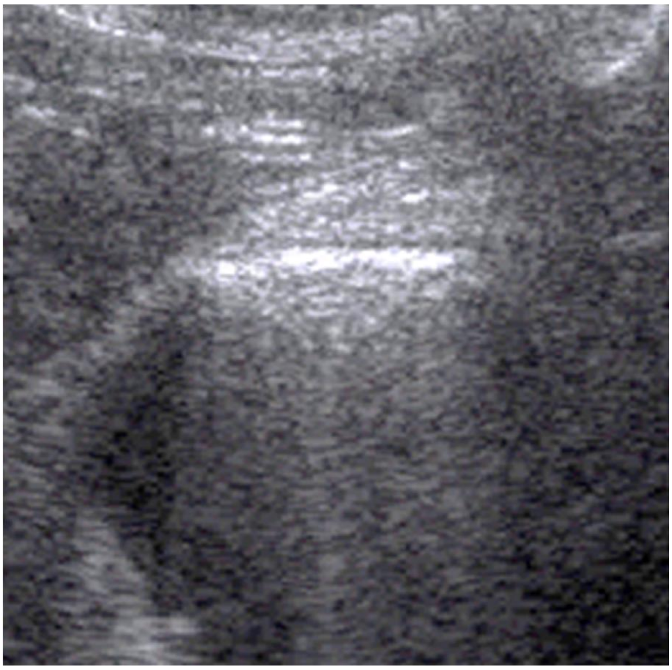


Fig.4.7.38 Aerocystia (clinical chronic sigma-diverticulitis with bladder fistula); LAS longitudinal

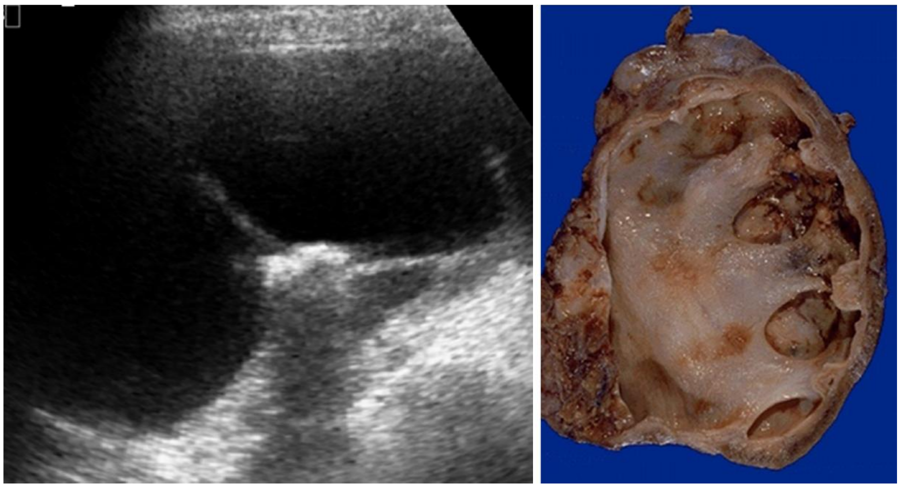


Fig.4.7.39 a, b Lithogenic hydronephrosis third degree; FS right (a)

Fig.4.7.40 Urinary bladder tumour with haemorrhage on coagulation; LAS longitudinal

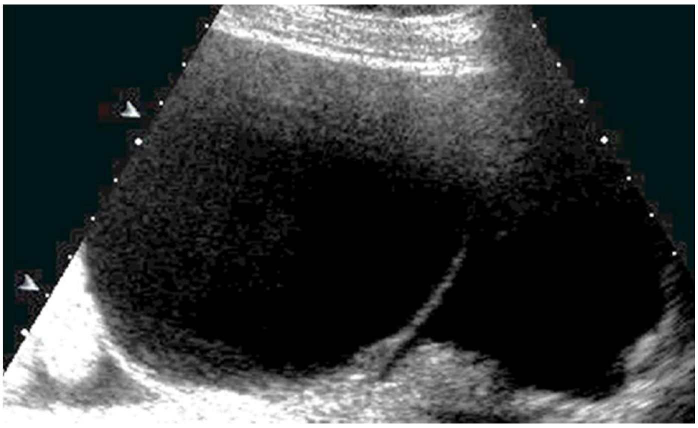


Fig.4.7.41 Ovarian cyst, ascites; LAS right

Fig.4.7.42 Partial cystic lower abdominal tumour (clinical ovarian cancer); LAS right

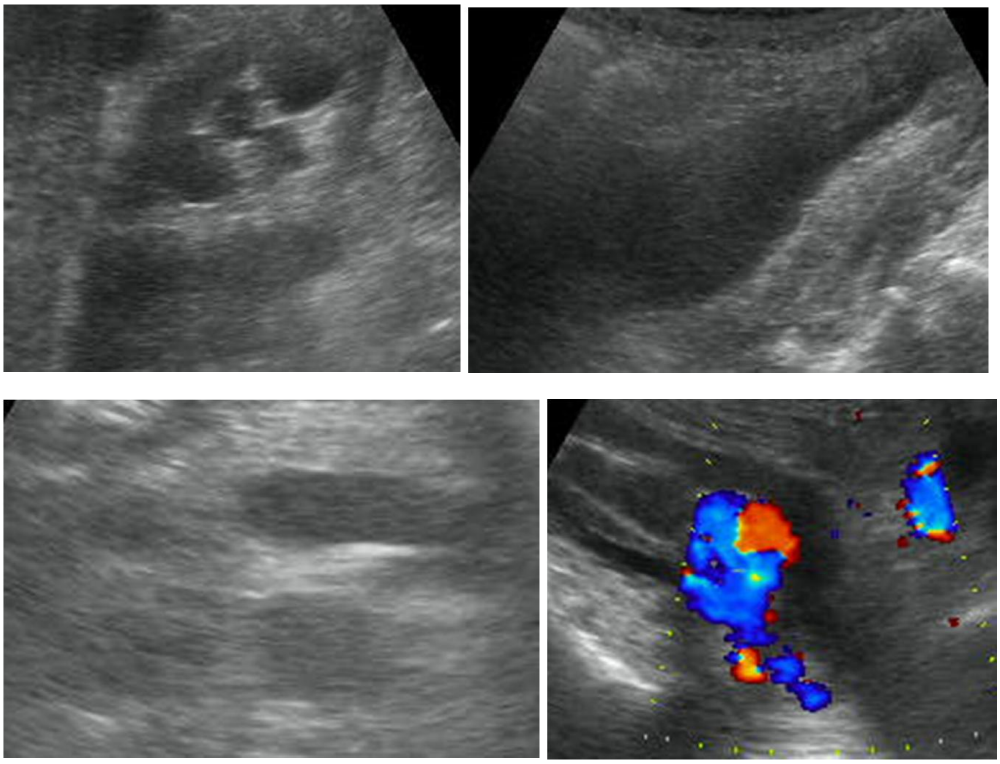


Fig.4.7.43 a-d Congested ureter with tumour (or calculous?) caused breakup; FS right

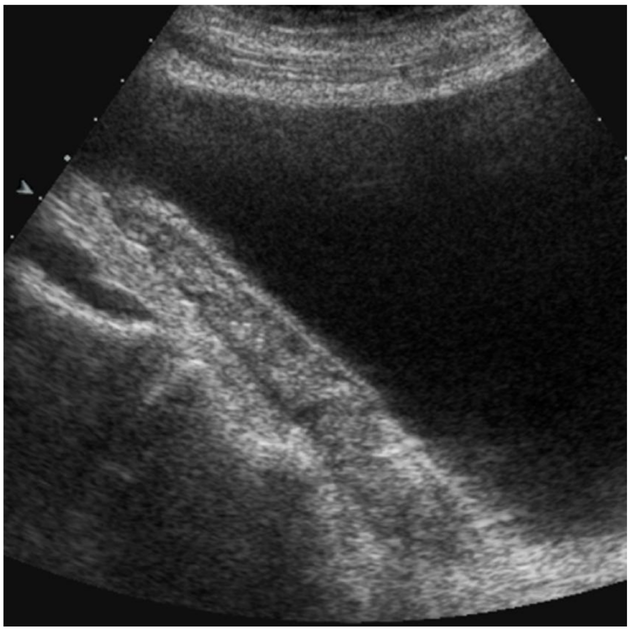


Fig.4.7.44 Minor amounts of ascites, well filled urinary bladder, unspecific enteritic thickened sigmoid loop; LAS longitudinal

Fig.4.7.45 Urinary bladder and penis prosthesis reservoir (top left) after gender reassignment surgeries; LAS longitudinal

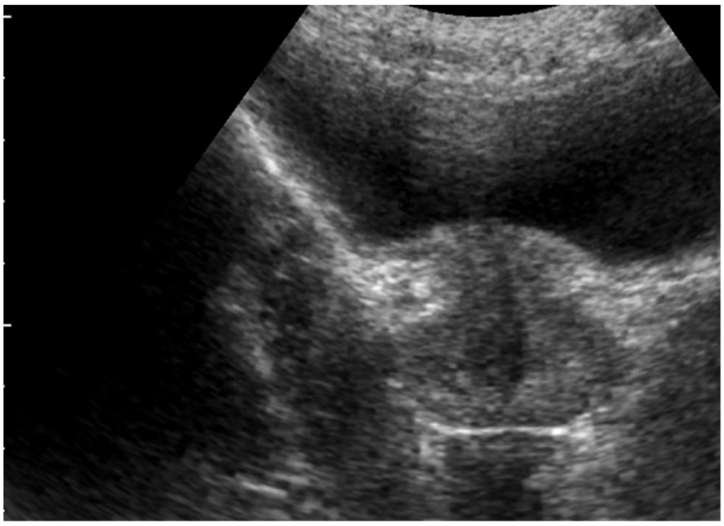


Fig.4.7.47 Urinary bladder and juvenile prostate, rectum, normal findings, LAS transverse

Besides intra-peritoneal structures also retro-peritoneally situated organs and regions have to be taken routinely into account.

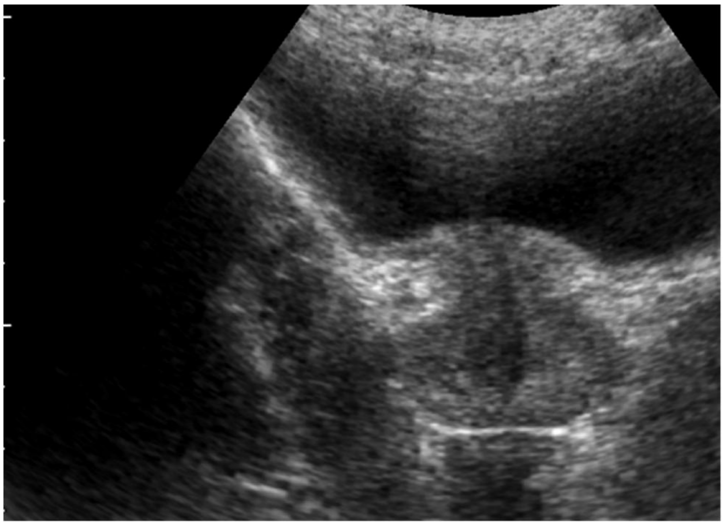


Fig.4.7.47 Urinary bladder and juvenile prostate, rectum, normal findings, LAS transverse

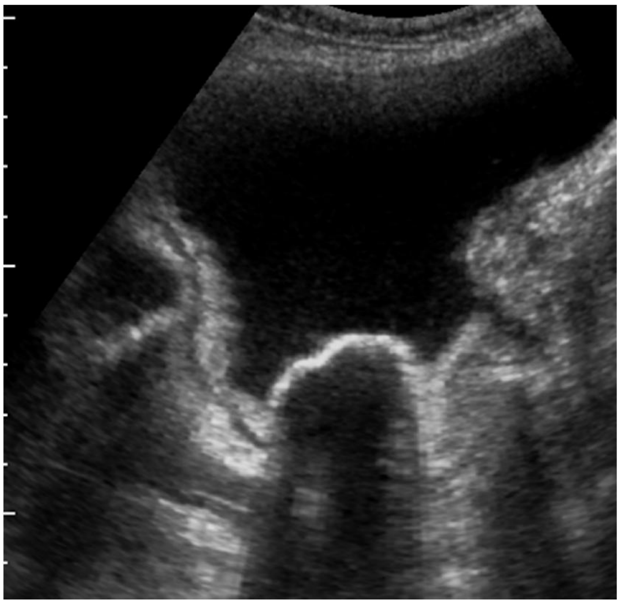


Fig.4.7.46 Urinary bladder calculi, vagina and truncated uterus sections normal; LAS longitudinal

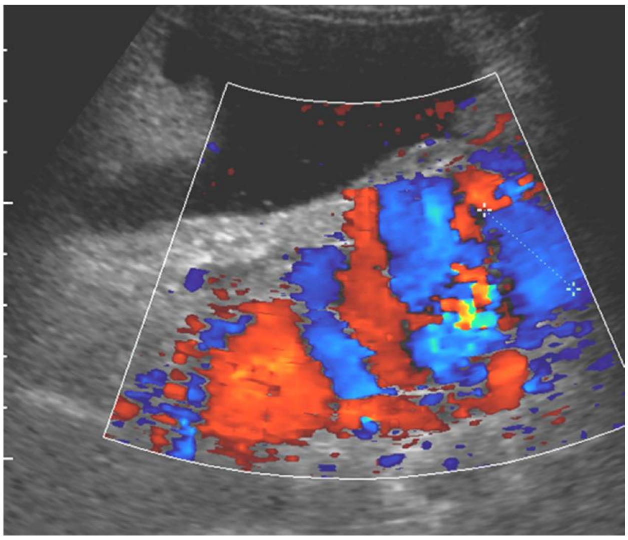


Fig.4.7.48 Portal hypertension with retro-peritoneal varicosis; FS right with CCDS; LAS transverse

Please note:

- ***always include in initial examination***
- ***scan every section from several planes***
- ***scrutinize renal pelvis***
- ***urinary bladder must be filled***

4.8 Gastrointestinal System

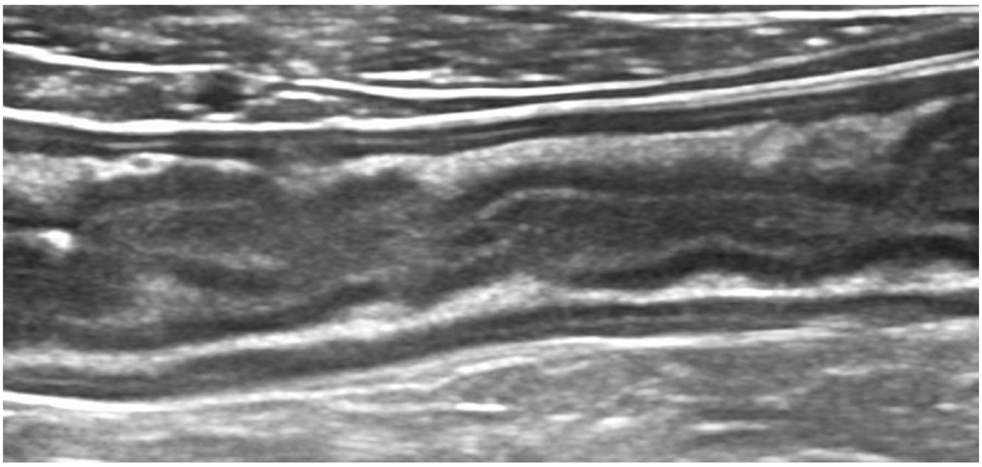


Fig. 4.8.01 hypertrophied intestine (clinical unspecific diarrhoea), clearly seen three layers (from the outside muscularis, high-reflex submucosa, and again poor reflex mucosa, lumen in centre); LAS transverse

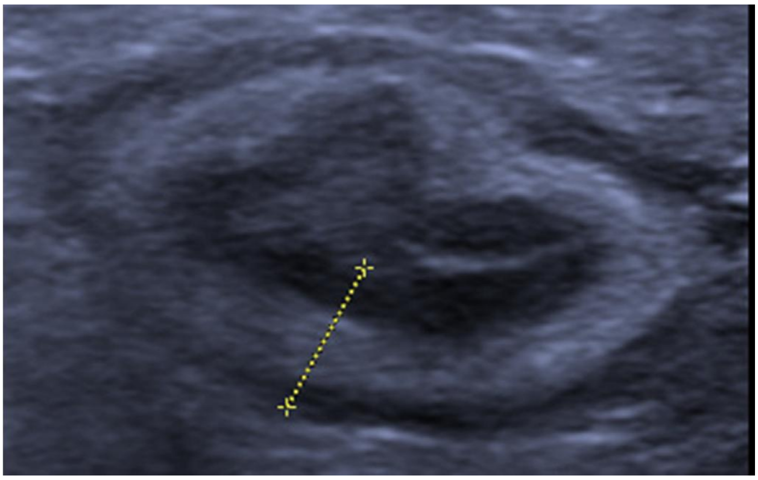


Fig. 4.8.02 Unspecific enteritides with increase particularly in high-reflex submucosa; UAS transverse

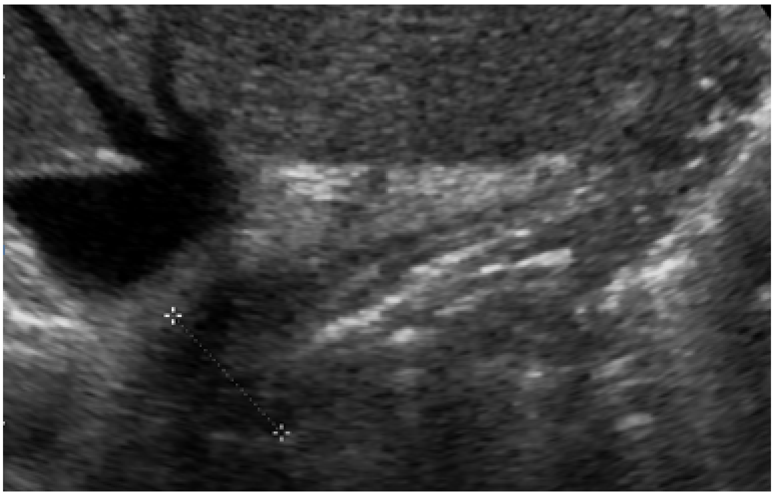


Fig. 4.8.03 Purulent terminal oesophagitis after injection of wall stabilizing particles; UAS longitudinal

Sonographic possibilities of oesophagus, stomach, as well as small and large intestines have only come into to the awareness of sonographers in recent years, a typical process: What has been considered thus far as bothersome (intestinal gas overlay), has unexpectedly become the centre of diagnostic interest. The ideal supplementation of sonography with endoscopy (and vice versa) is pointed out again.

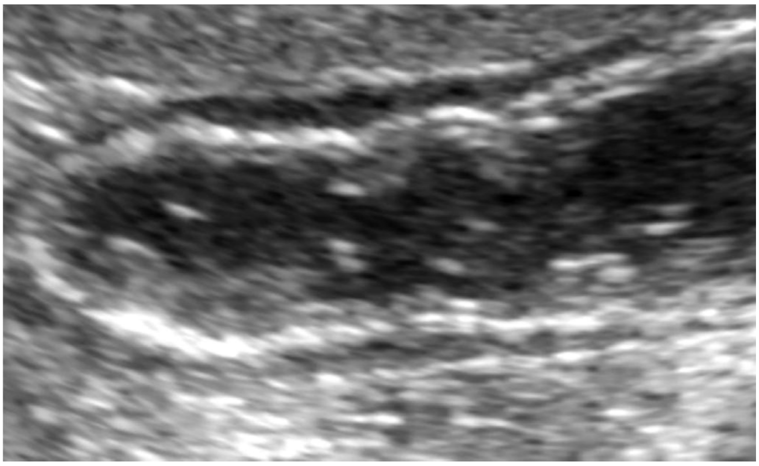


Fig. 4.8.04 The muscular layer, submucosa and mucosa, the normal three-layered structure of the intestine, is shown exemplarily in the gastric antrum; UAS transverse

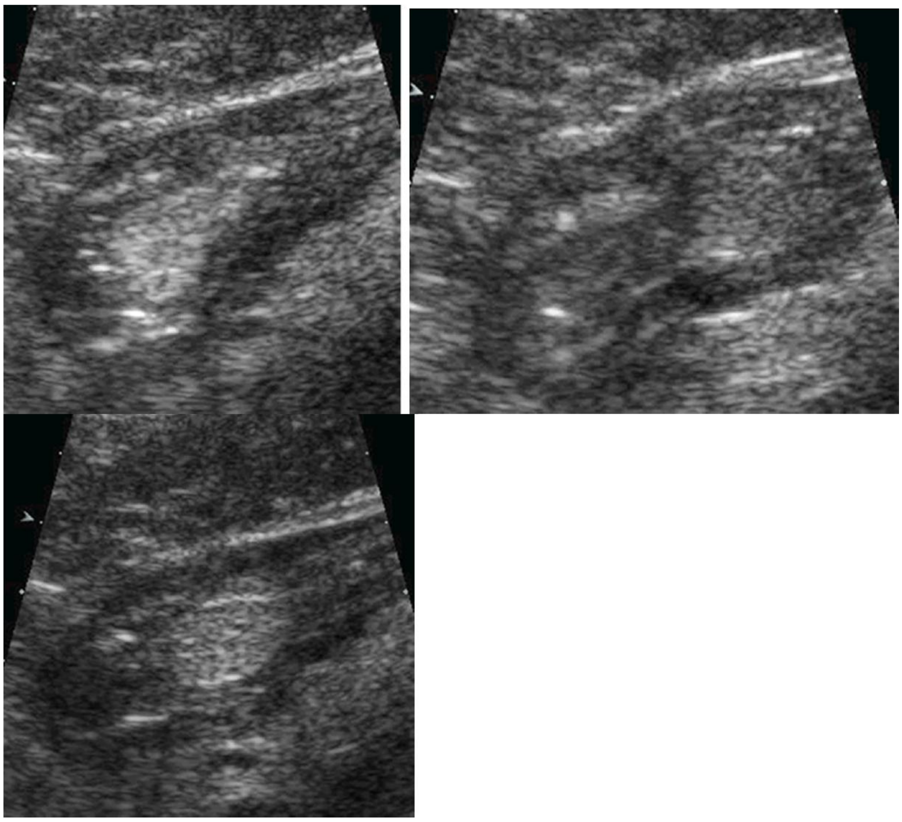


Fig. 4.8.05 a-c Peristalsis-mobile antrum polyp, prolapsing into the duodenal bulb (a, b); UAS transverse

Fig. 4.8.06 Linitis plastica (“leather bottle stomach”) causing parietal hypertrophy and infiltration into gastric antrum; UAS transverse

Fig. 4.8.07   Normal layers of water-filled antrum bulb area; UAS transverse

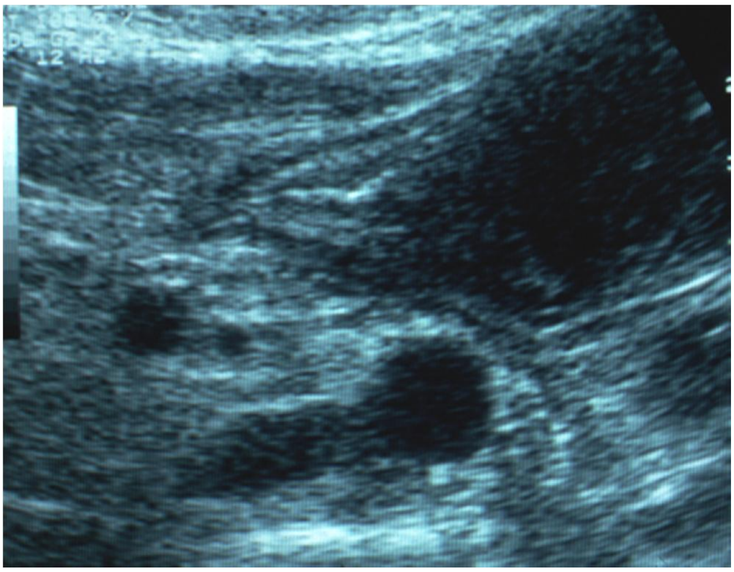


Fig. 4.8.08   Gastric wall tumour (clinical myoma); SCS left

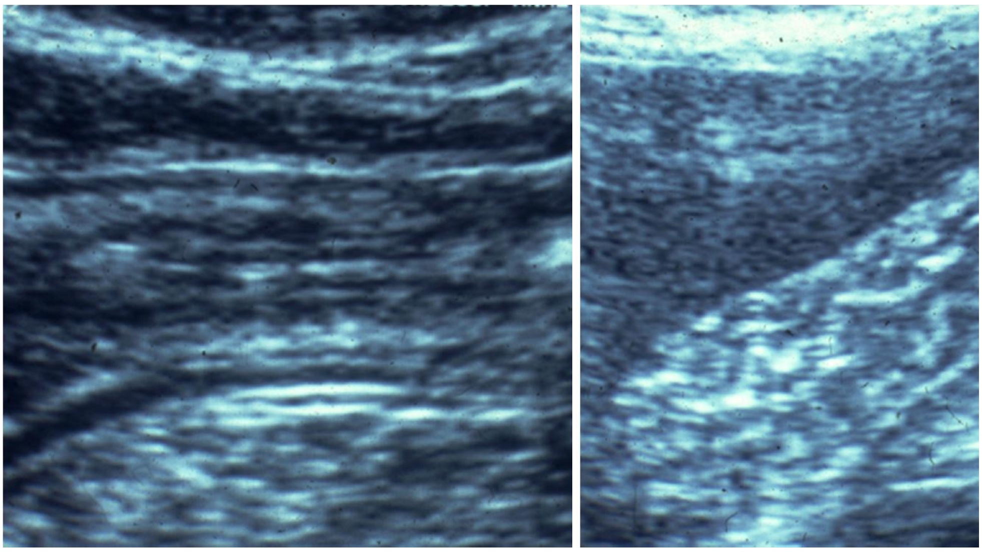


Fig. 4.8.09 a, b Normal parietal cell layers and mucosa folds; UAS transverse (a) and SCS left (b)

Fig. 4.8.10 Also in real life, very thin-walled intestinal loops; pre-war observation at the Aleppo souk (market)

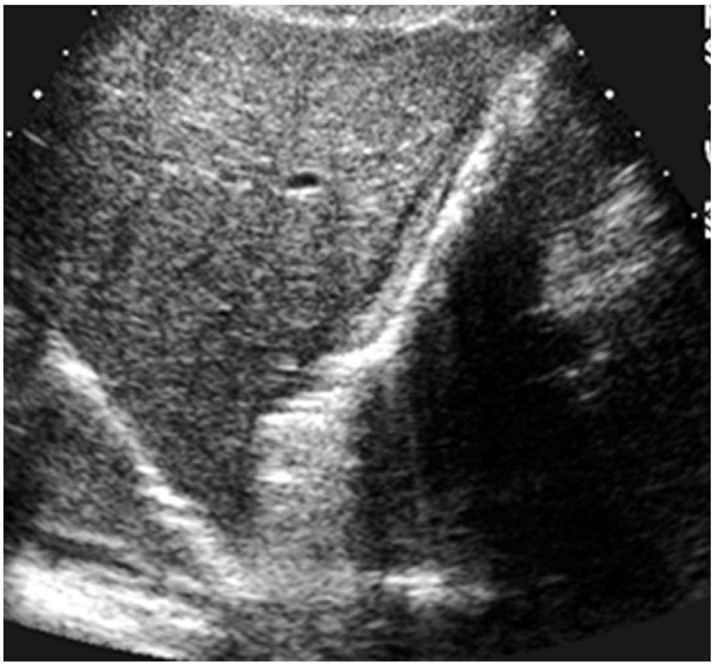


Fig. 4.8.11 Etiologically unclear remaining and spontaneously over months regressing gastric wall hypertrophy; UAS transverse

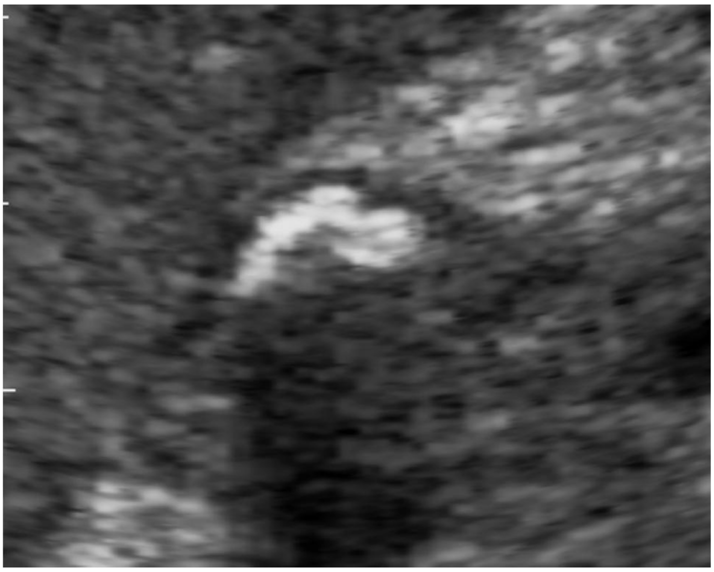
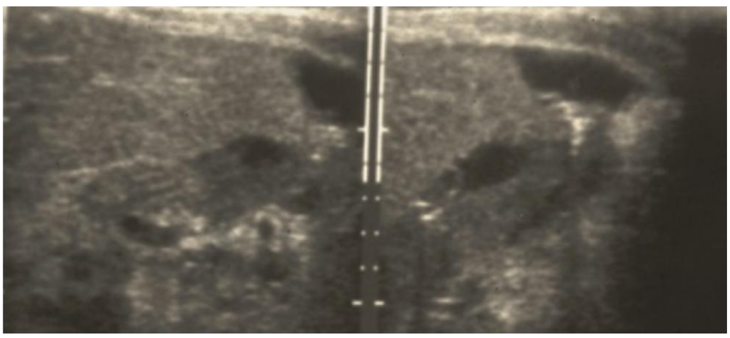


Fig. 4.8.12 Ulcer of the duodenal bulb; UAS transverse



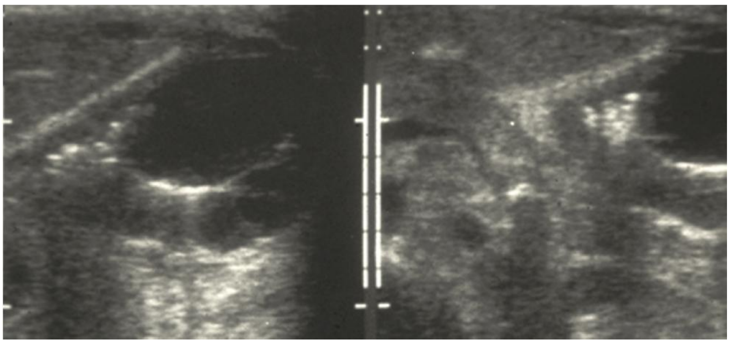


Fig. 4.8.13 a-d Phlegmonous gastritis after ingestion of lye; SCS left

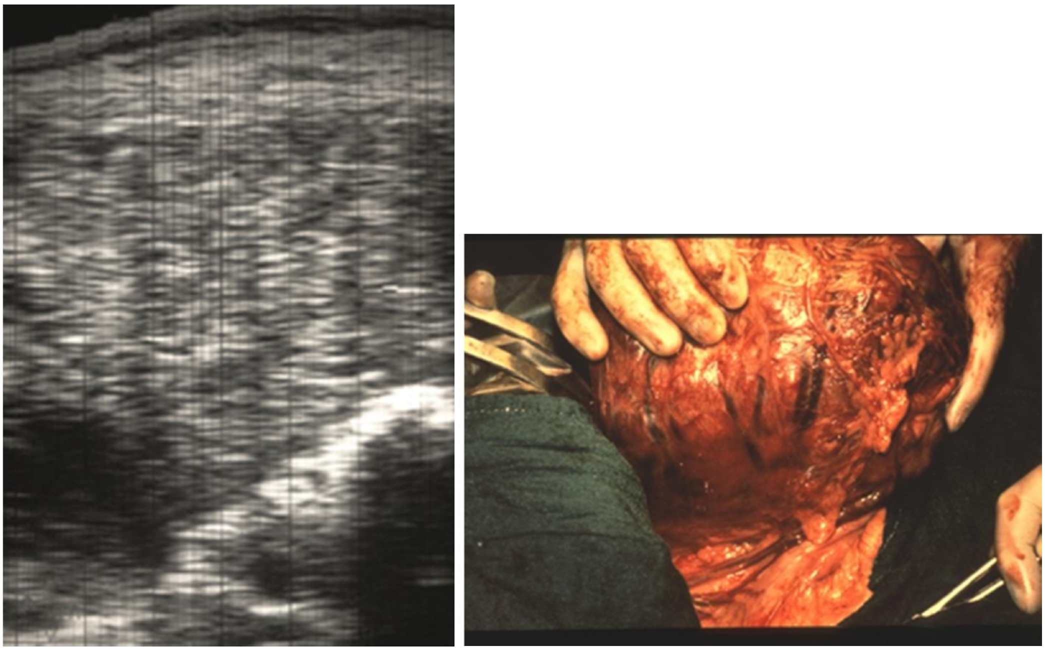


Fig. 4.8.14 a, b Neurinoma (about 2.5 kg weight) of posterior gastric wall; SCS left
(a)

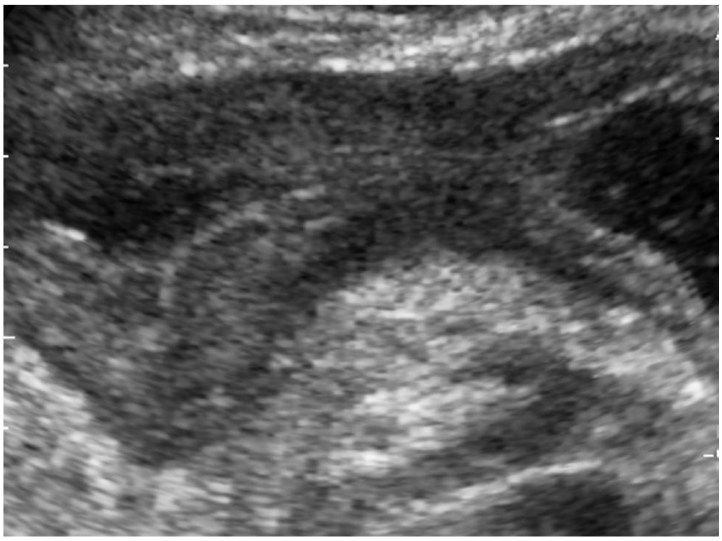


Fig. 4.8.15 Malign antrum wall hypertrophy; UAS transverse

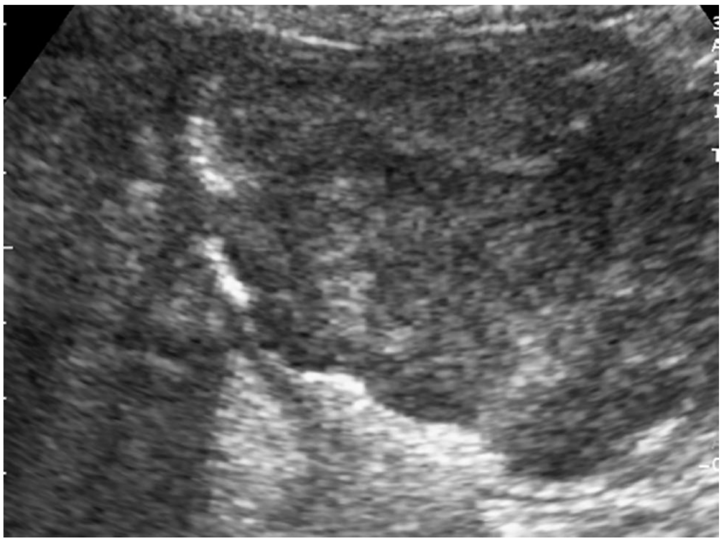


Fig. 4.8.16   Gastric wall tumour; SCS left

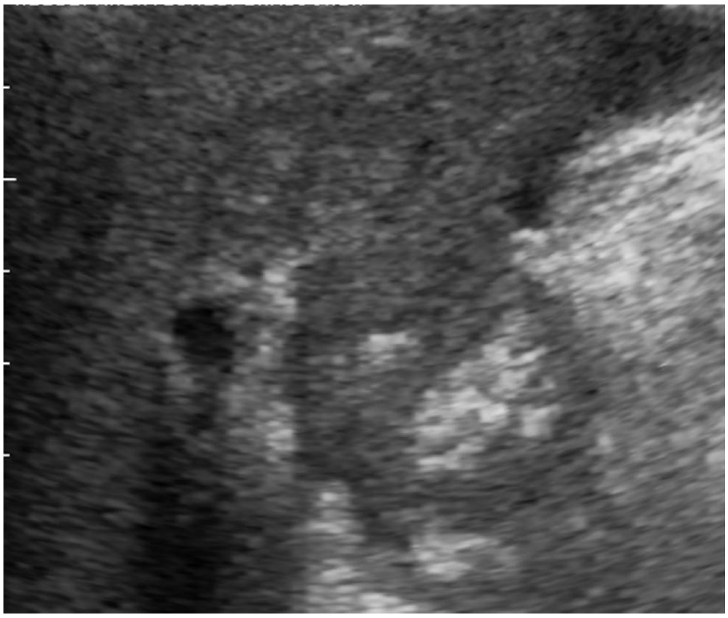


Fig. 4.8.17   Antrum wall tumour (separating from liver with breathing movements); UAS transverse

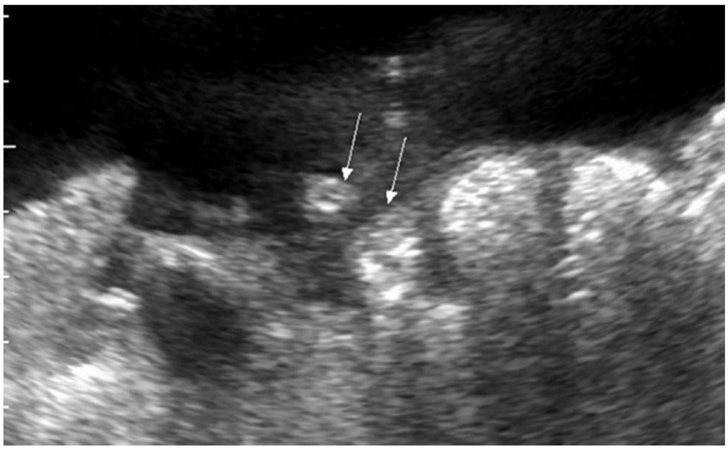


Fig. 4.8.18   Peritoneal carcinosis nodule LAS transverse; LAS transverse

Fig. 4.8.19   Mostly emptied Mainz pouch; LAS transverse

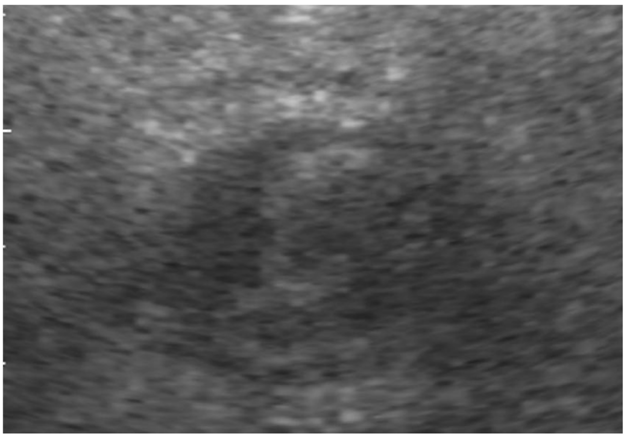


Fig. 4.8.20   Intestinal wall hypertrophy by colon wall phlegmons (sonography guided puncture and antibiotic conservative cure); LAS transverse

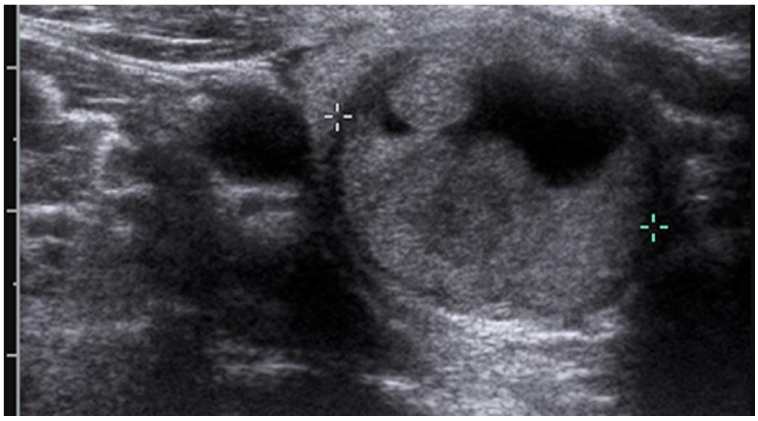


Fig. 4.8.21 Unclear remaining changes in intestinal wall – wall thickening and vivid peristalsis (Sprue?); MS

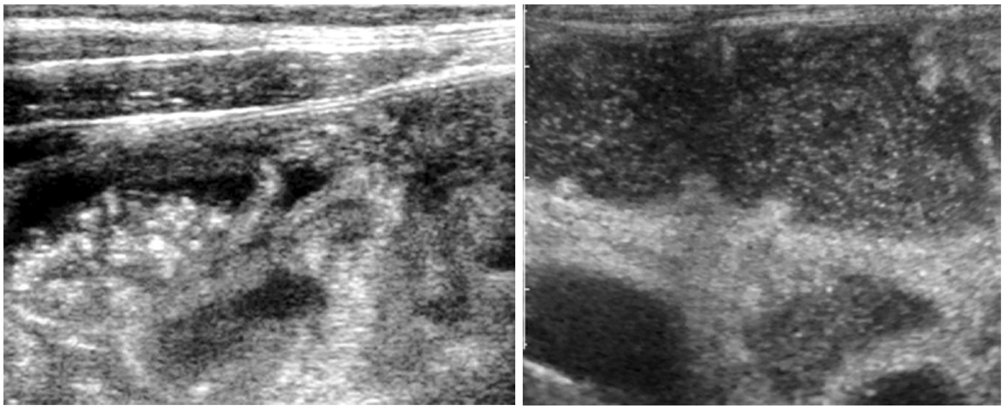


Fig. 4.8.22 a, b Two different patients with extremely vivid peristaltic movement in dilated and partly thickened small intestinal loops, filled with diarrheal faeces, ascites - typical Sprue symptom; LAS longitudinal

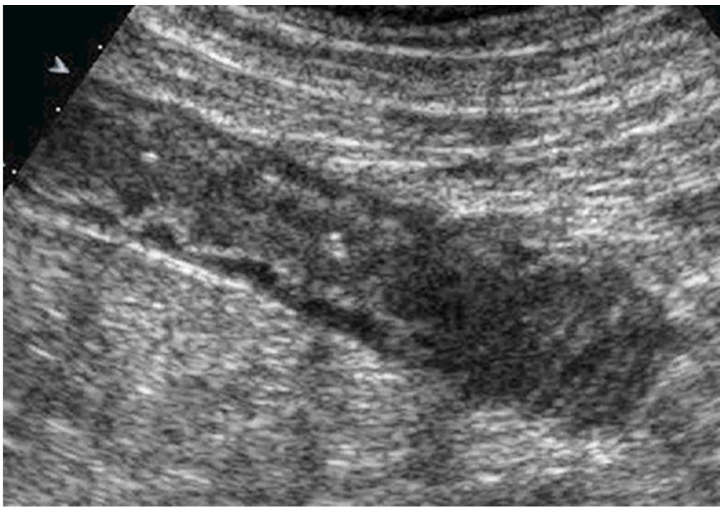


Fig. 4.8.23 Enteritis with thickened small intestinal loop; LAS longitudinal

Fig. 4.8.24 Small intestinal invagination due to a polyp; UAS transverse

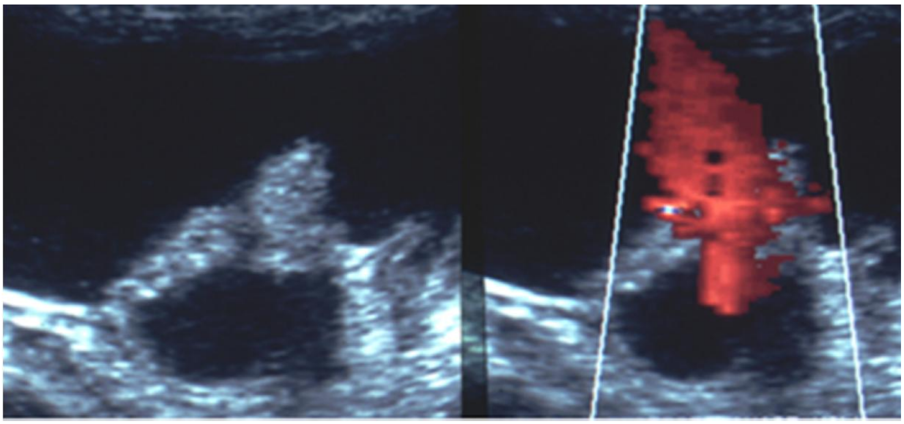


Fig. 4.8.25 Normal ileocecal valve; LAS transverse (b with CCDS); LAS longitudinal

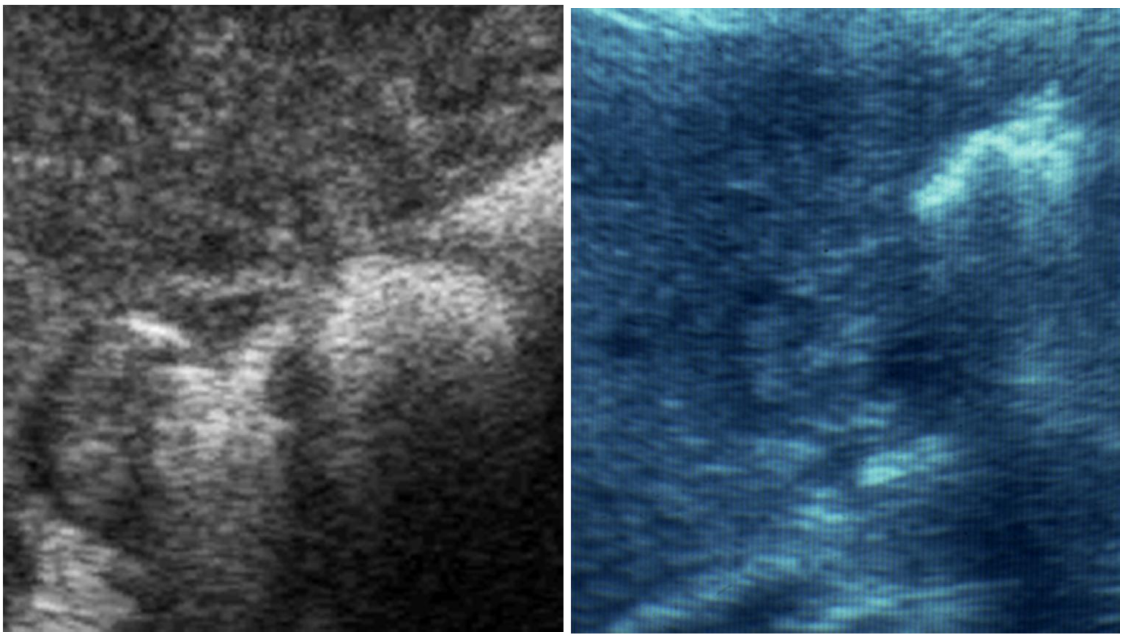


Fig. 4.8.26 a, b Two cases with different growth stages of not (yet) invasive (a) and partly liver infiltrating malign tumours (b) of right flexure (T 4); FS right

Fig. 4.8.27 Large retro-peritoneal abscess, urine congestion of the first degree; FS right

Fig. 4.8.28 Radiogenic colitis; LAS transverse

Fig. 4.8.29 Extensive sigma carcinoma, wall thickening and central residual gas (no air!); LAS longitudinal

Often real-time images, especially of the intestine, visualize more than can be laboriously verbalized. This is typical for enteritic as well as for rare, chronic-inflammatory processes, and together with the typical medical historic findings of Crohn's disease, and lastly when malign parietal hypertrophy is suspected.

The changes are principally the same: Destruction of the normal (sonographically well representable) three-layer structure by (chronic or acute) inflammatory or malign processes.

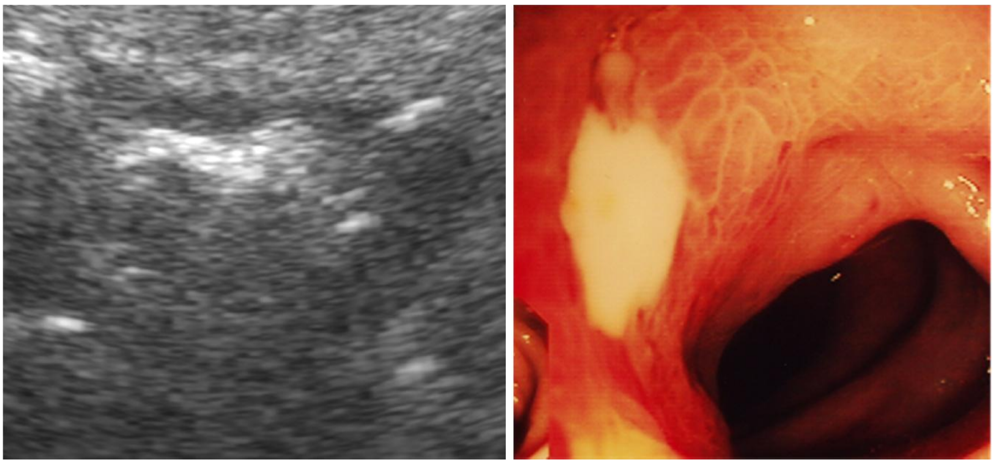


Fig. 4.8.30 a, b Purulent diverticulitis with phlegmonous abscess forming inflammation; LAS longitudinal (b)

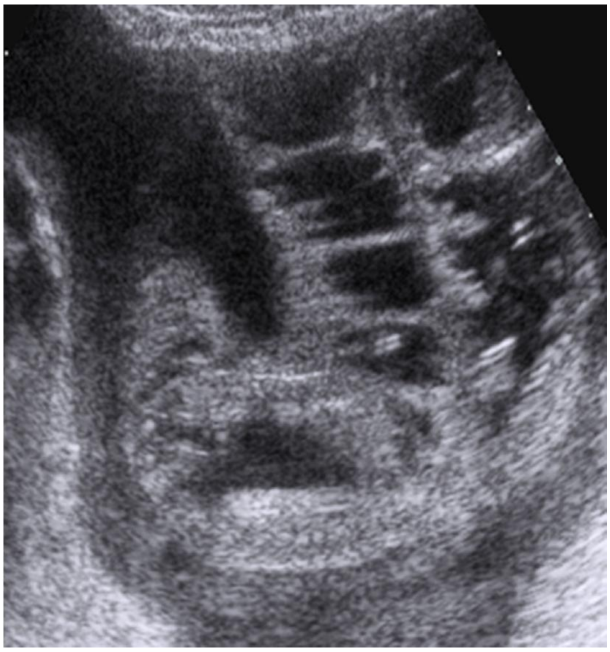


Fig. 4.8.31 Obstruction of the small intestine, ascites; LAS longitudinal

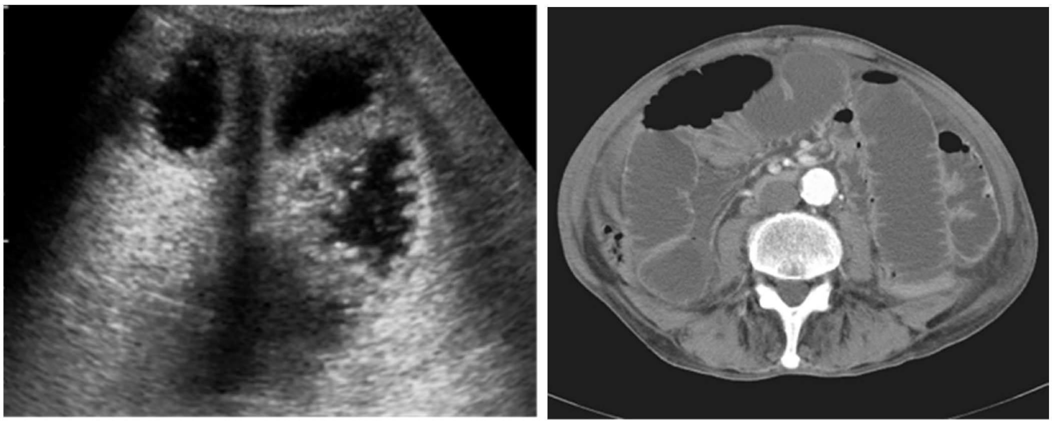


Fig. 4.8.32 a, b Obstruction of the small intestine, thickened circular folds (valves of Kerckring): mid abdominal sections (left image half); LAS transverse

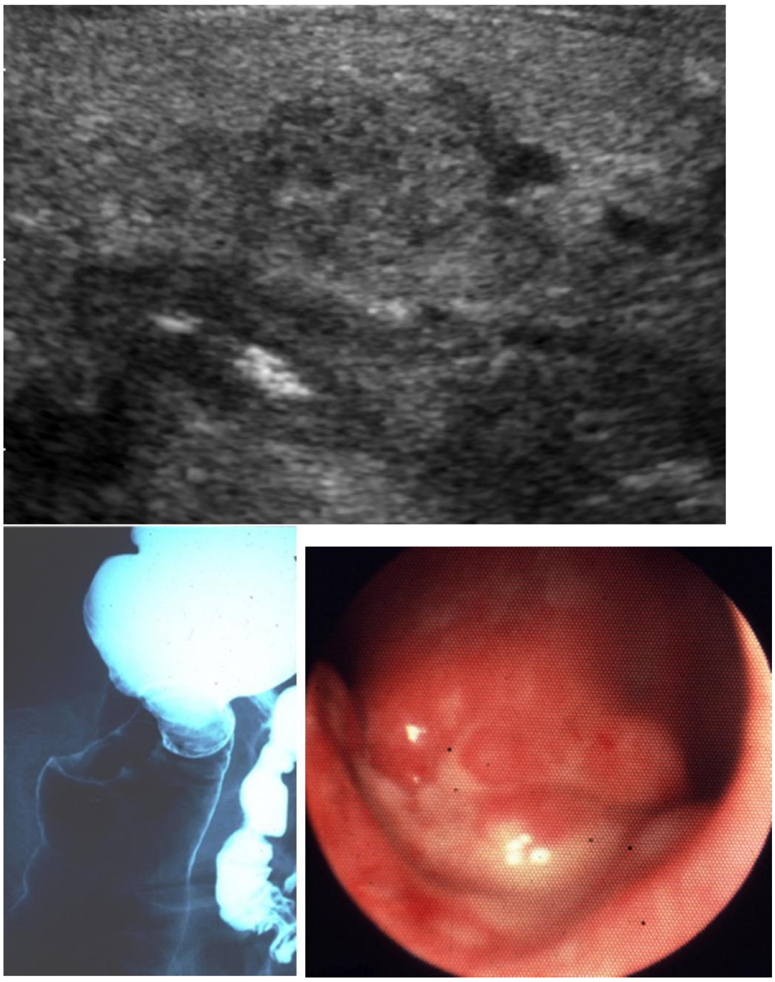


Fig. 4.8.33 a-c Colon cancer, x-ray (b) and endoscopic (c) view (b)

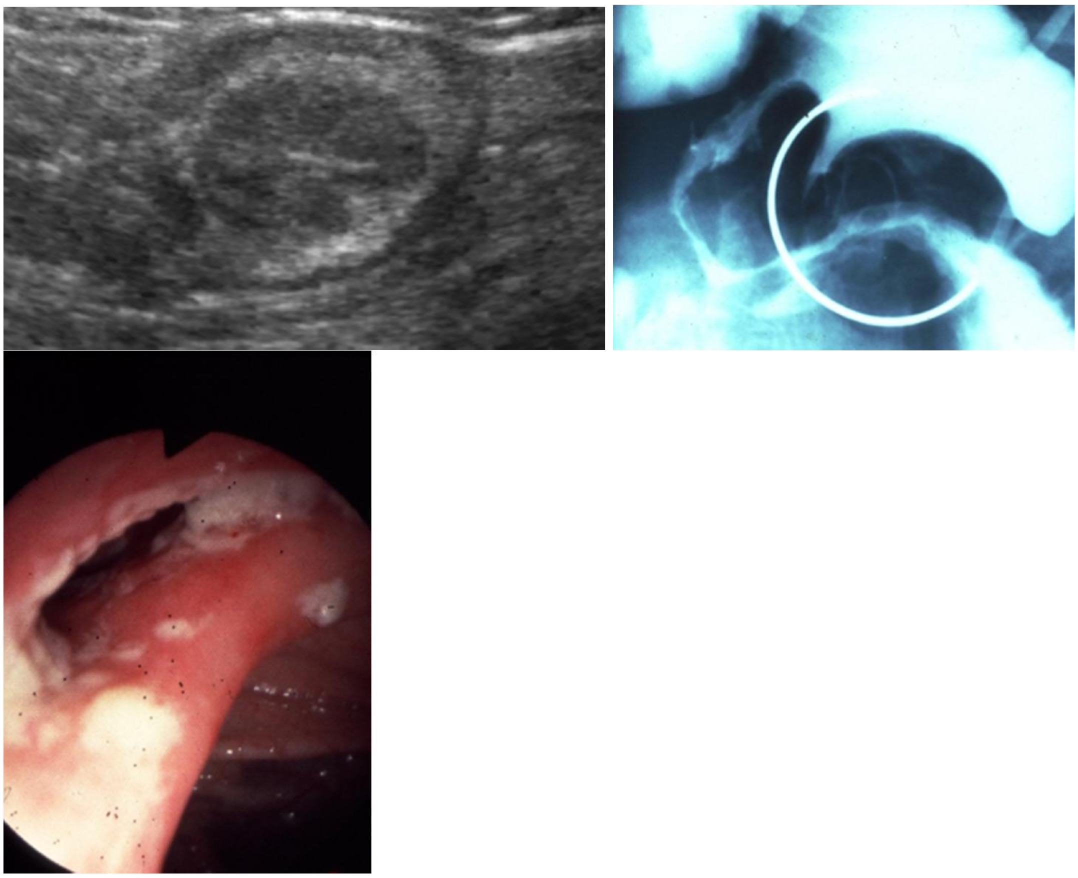


Fig. 4.8.34 a-c Hypertrophied and by chronic-inflammation partially destroyed ileocecal valve, clinically known Crohn's disease, LAS transverse (a) or conventional radiologic (b) and endoscopic depiction (c)

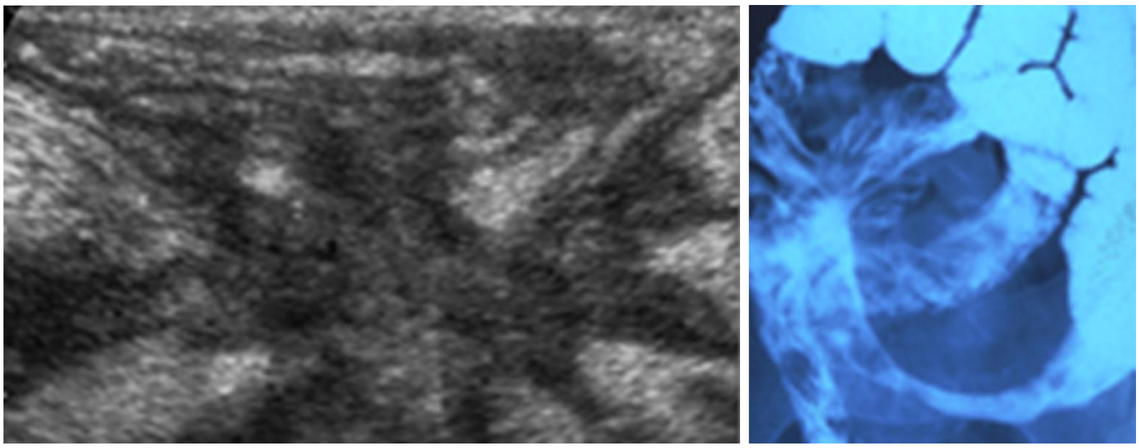


Fig. 4.8.35 a, b Inter-enteritic fistulas in Crohn's disease; complete sonographic aspect left image half; LAs transverse (a)

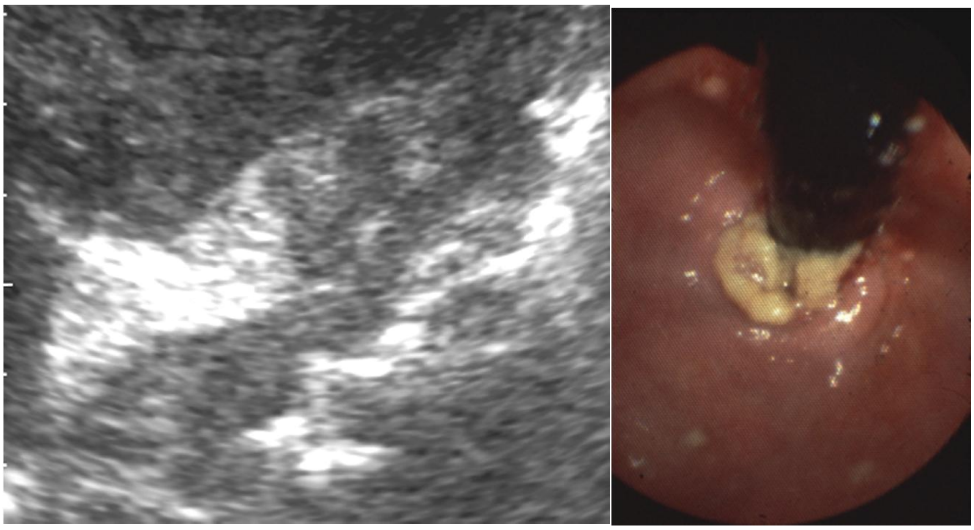


Fig. 4.8.36 a, b Parietal hypertrophy and lymphatic metastasizing oesophagus tumour (history of "deep" dysphagia) (clinical cancer confirmed by sonography guided puncture cancer); UAS longitudinal

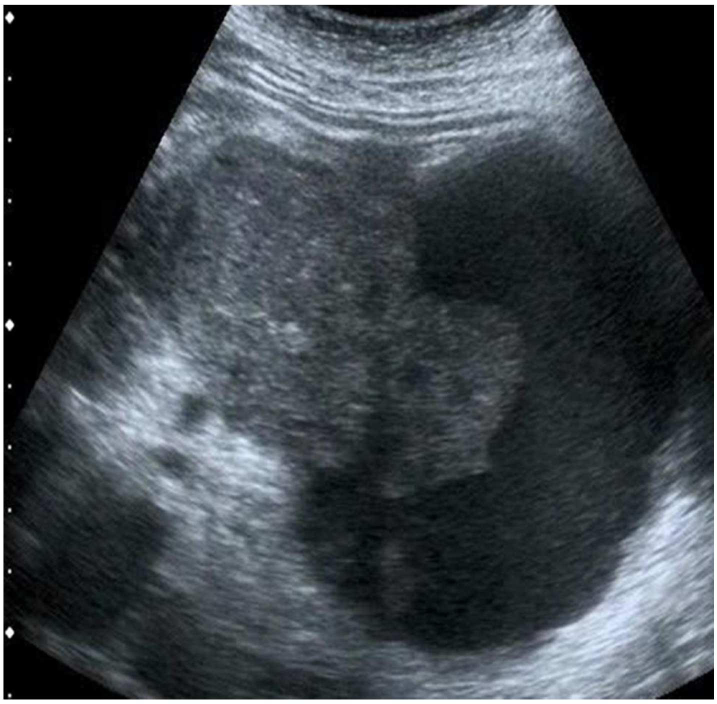


Fig. 4.8.37 Gastric wall tumour, not yet infiltrating (respiration associated movement); SCS left

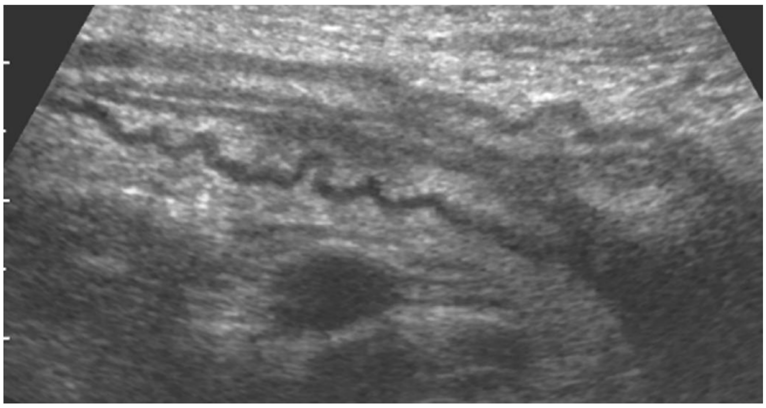


Fig. 4.8.38 Hypertrophied wall of small intestinal loop; overall clinical picture of unspecific enteritis; LAS longitudinal

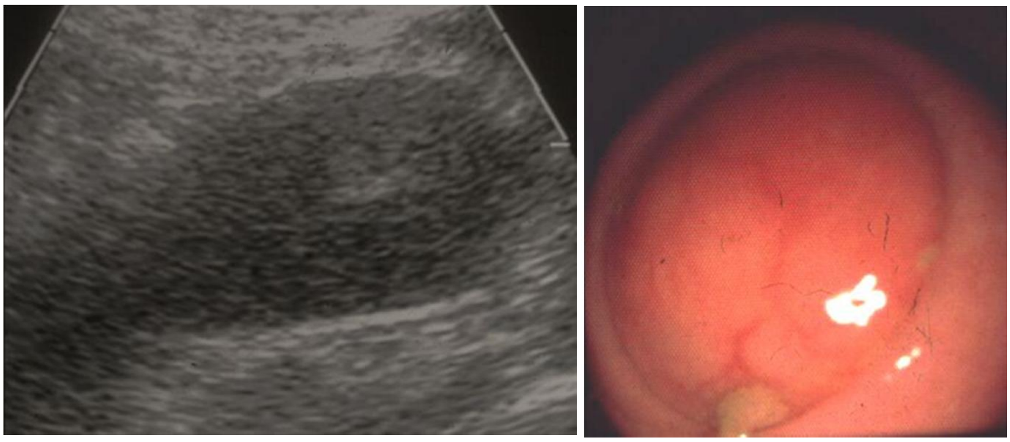


Fig. 4.8.39 a, b Mucocele (mucous retention cyst) of appendix; FS right (b: endoscopic view) (do not puncture! danger of pseudomyxoma!)

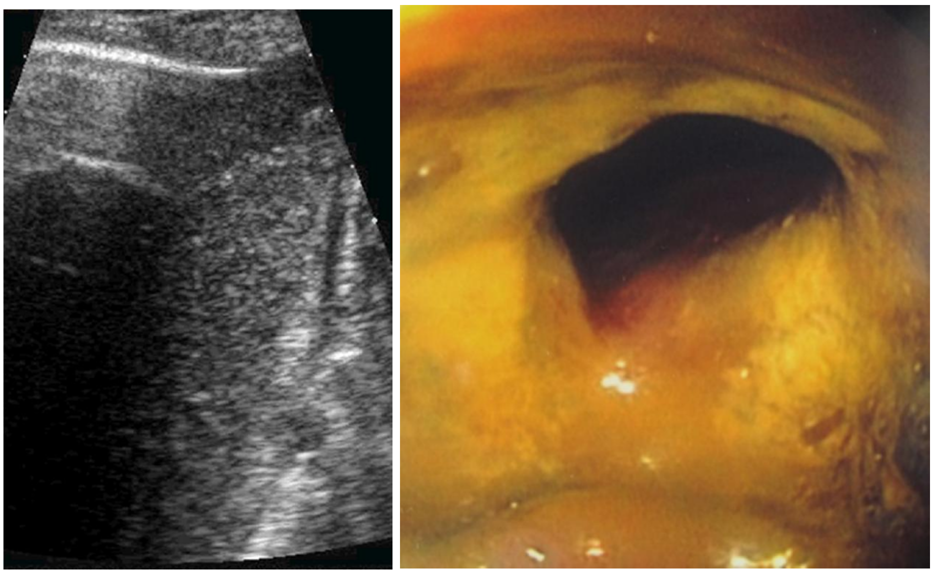


Fig. 4.8.40 a, b Perforated bulb ulcer (in a, right gas-typical horizontal reflex) with some escaping liquid and gas (in a above) also between the liver and abdominal wall; UAS longitudinal; immediate surgery following (no CT!)

Rare clinical pictures such as achalasia or gallstone obstruction are nicely substantiated by sonography in combination with the typical medical history. Additionally duplication with optically refined inspection, namely endoscopy, is unrivalled in their combination and extraordinarily successful. Clinical information facilitates correct allocation of intestinal sonographic findings.

The not so entirely rare celiac disease (Sprue) is characterized by the easily verifiable hyperperistalsis of the thickened small intestinal loops chronically modified by inflammation. Some concomitant ascites belongs to the full picture of the illness, often only diagnosed by diet (the relevant antibodies fail repeatedly).

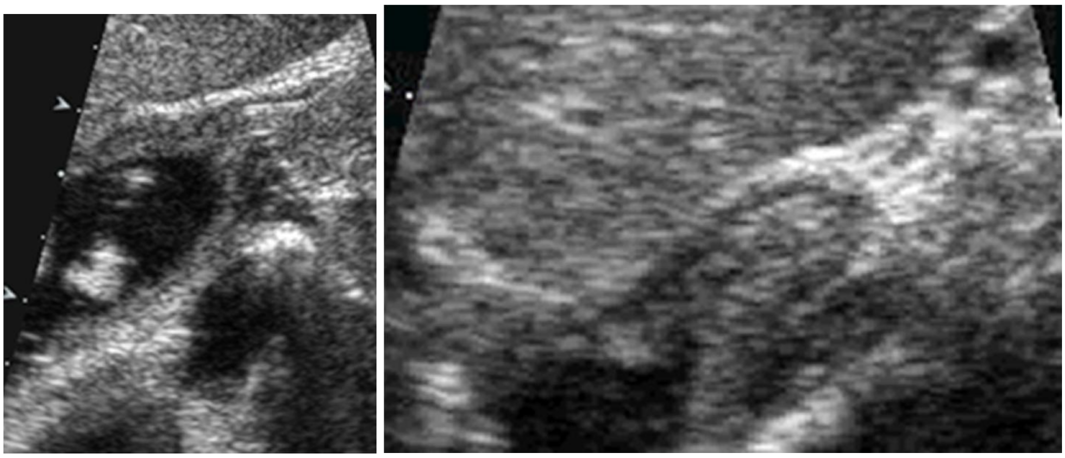


Fig. 4.8.41 a, b Atrophied congested oesophagus in achalasia, food remnants; UAS longitudinal

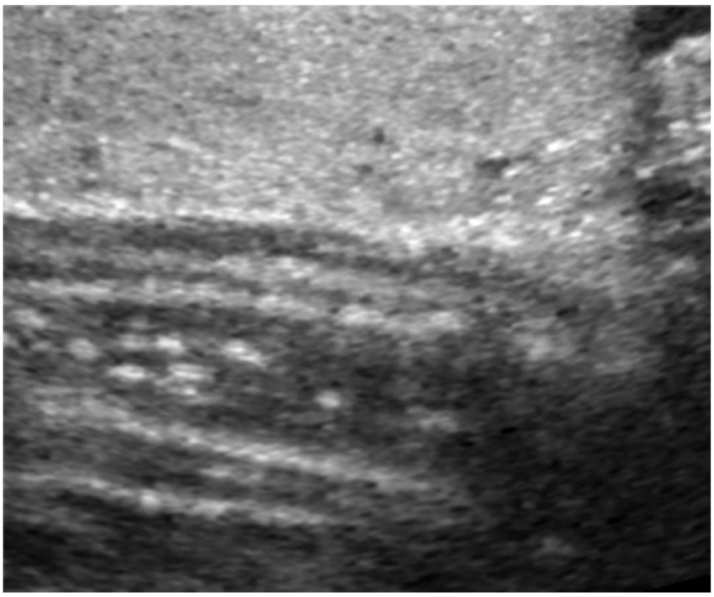


Fig. 4.8.42 Normal cervical oesophagus, left thyroid gland lobe; cervical longitudinal sections

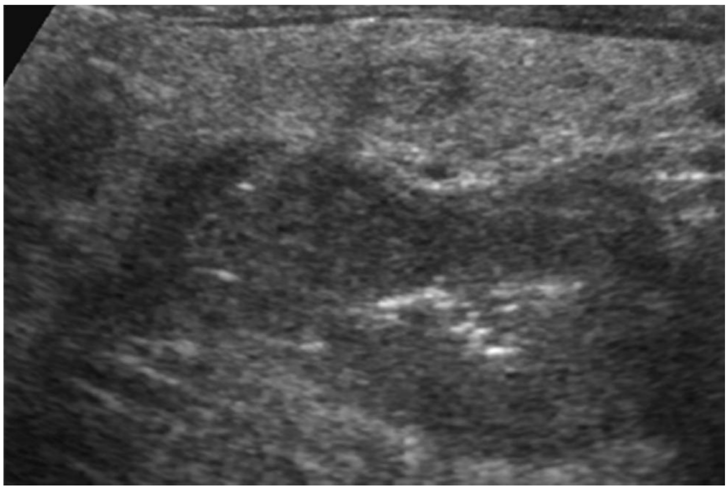


Fig. 4.8.43 Cervical oesophagus tumour (history of "high" dysphagia), secondary diagnosis with FS of left thyroid gland lobe; cervical longitudinal sections

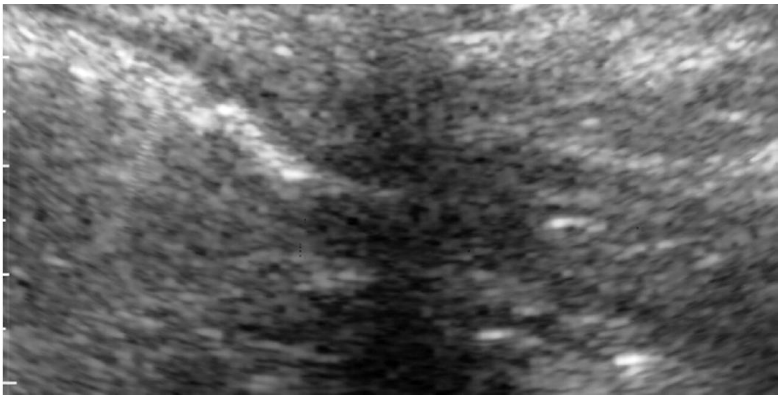


Fig. 4.8.44 Late breast cancer metastases growing into the descending colon with stenosis of the left flexure; FS left

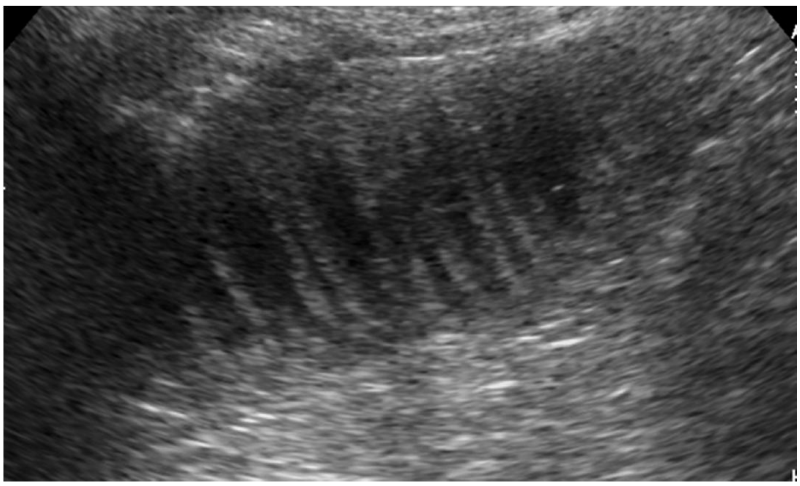


Fig. 4.8.45 Congested ileum with hypertrophied circular folds (valves of Kerckring), typical mechanical obstruction (strong peristalsis); LAS longitudinal

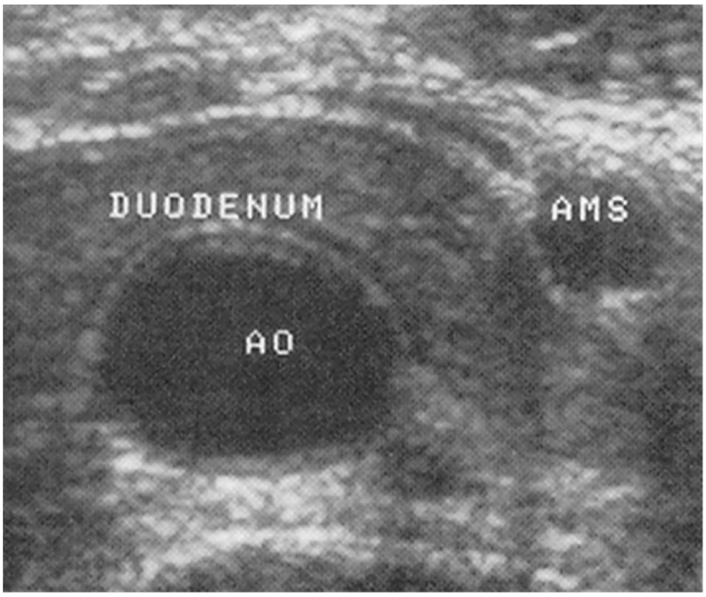


Fig. 4.8.46 Optimal image with high resolution transducer of horizontal part of the duodenal C, due to arteriosclerosis (aged individual!), superior mesenteric artery is more to the left; UAS transverse

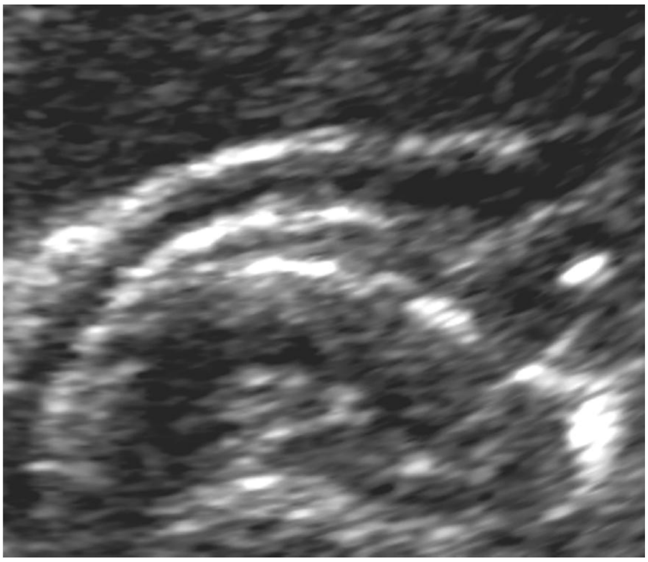


Fig. 4.8.47 Hypertrophied cardia wall probably in axial sliding hiatal hernia; UAS longitudinal

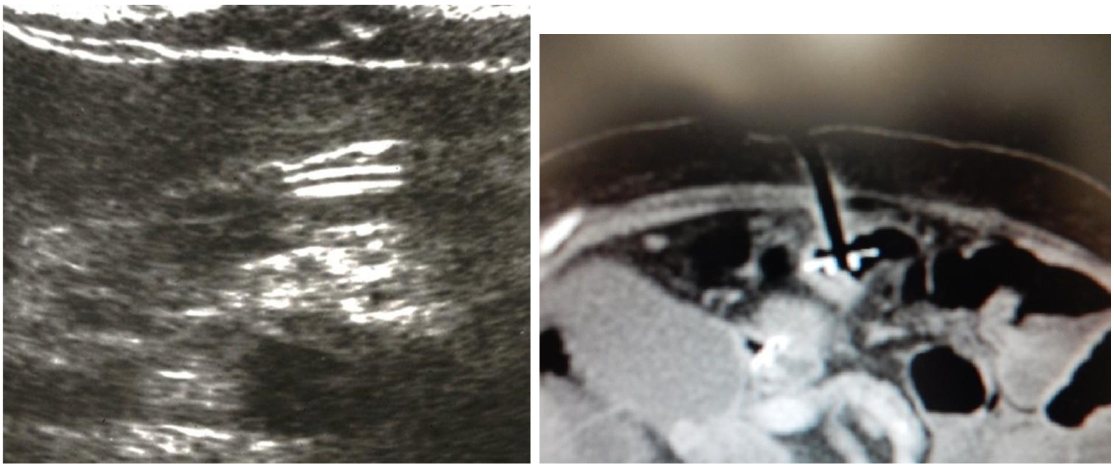


Fig. 4.8.48 a, b Properly installed percutaneous endoscopic gastrostomy plate (PEG); UAS transverse

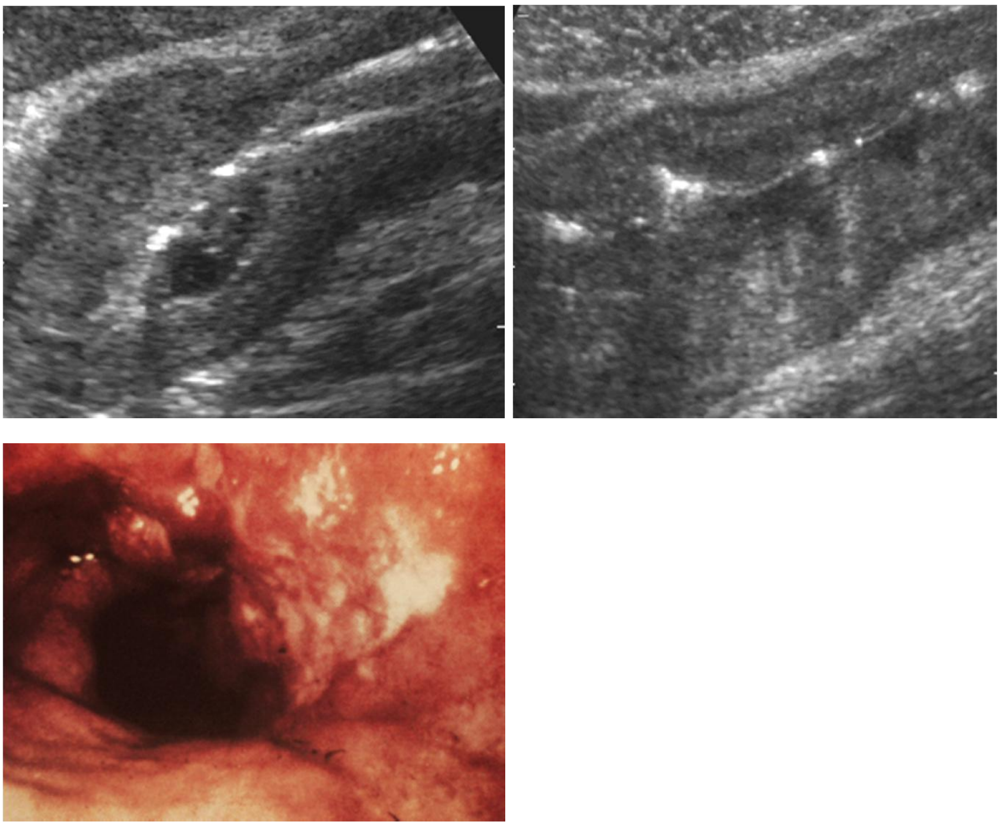


Fig. 4.8.49 a-c Linitis plastica (“leather bottle stomach”) bilateral of gastric antrum and body, sonographic (a, b) and endoscopic (c) aspect limited to mucosa, local pressure pain; UAS transverse (a, b)

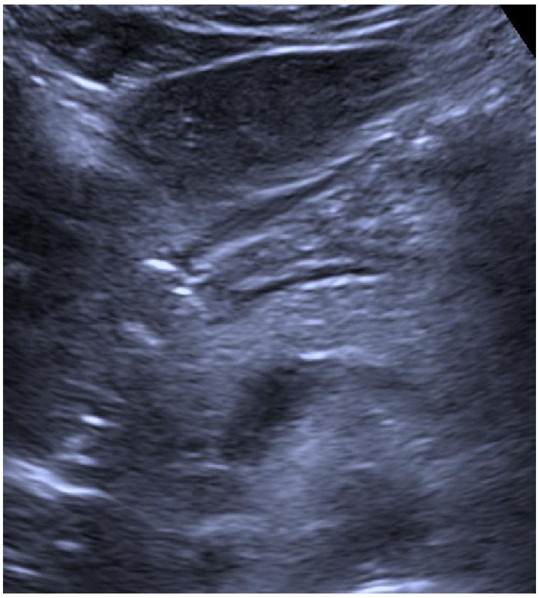


Fig. 4.8.50 Antrum anterior and posterior wall, closed pylorus as well as gas in bulb, pancreas and confluence; UAS transverse

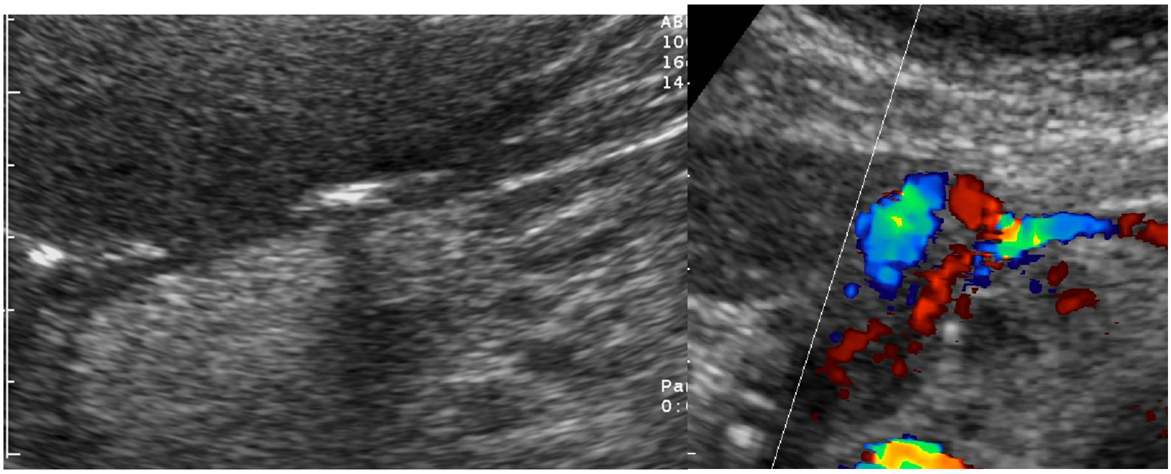


Fig. 4.8.51 Compression effect: by comprising away the interfering gastric gas in the corpus (a) better image of the (atrophic) pancreas (b), as well as the antrum with anterior thickened wall; UAS transverse in deep inspiration (two cases)

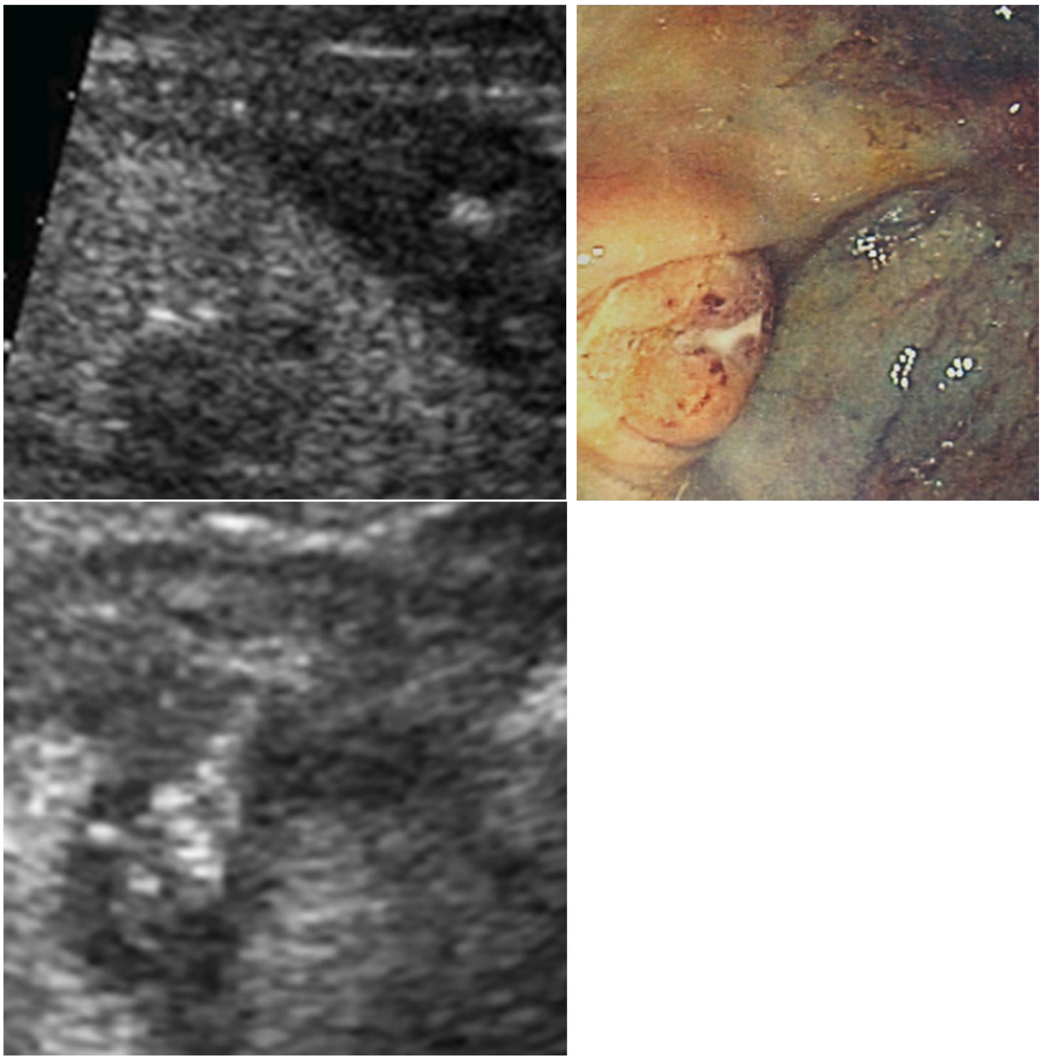


Fig. 4.8.52 a-c Acute purulent diverticulitis with covered perforation (clinical acute abdomen); LAS longitudinal and transverse (sonographic picture (a, c) with abscess and gaseous trail in b)

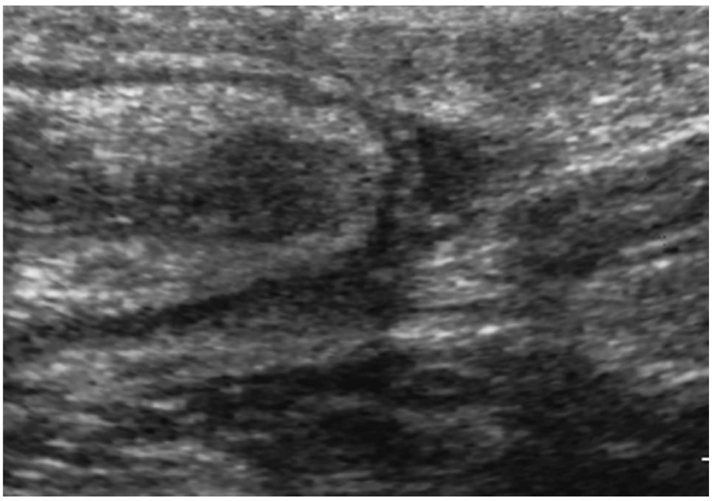


Fig. 4.8.53 Acute necrotizing appendicitis with mostly abscess forming appendix, faded and correspondingly difficult to visualize, cecal pole concomitantly inflamed and swollen; LAS longitudinal

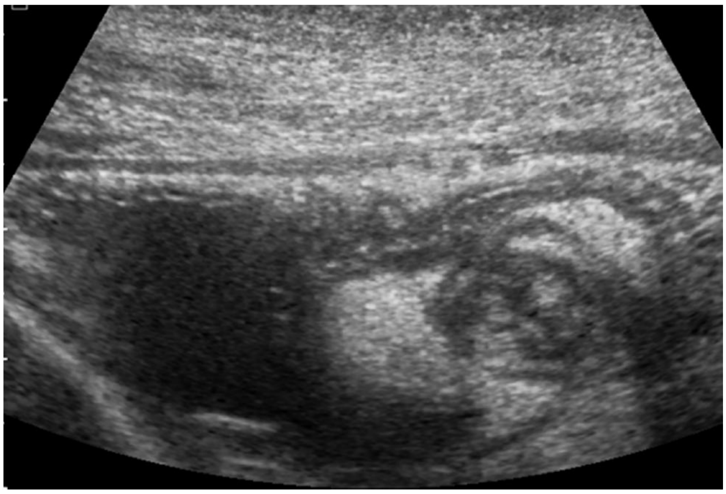


Fig. 4.8.54   Lipomatous valve; LAS transverse

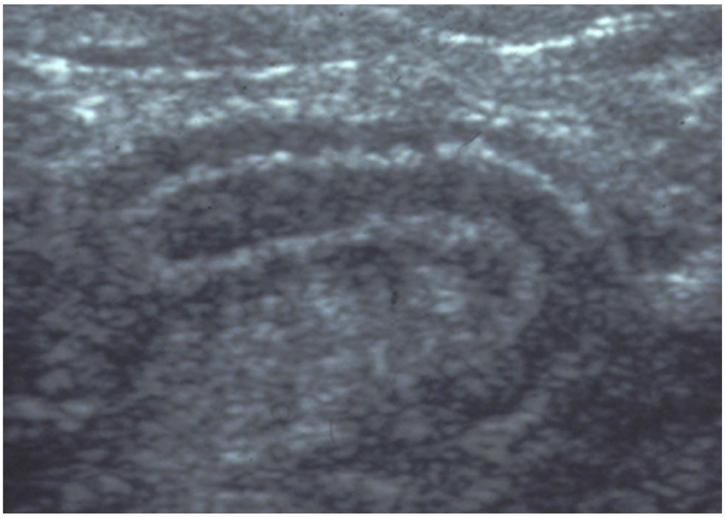


Fig. 4.8.55   Acute appendicitis (local pain, swelling); LAS right

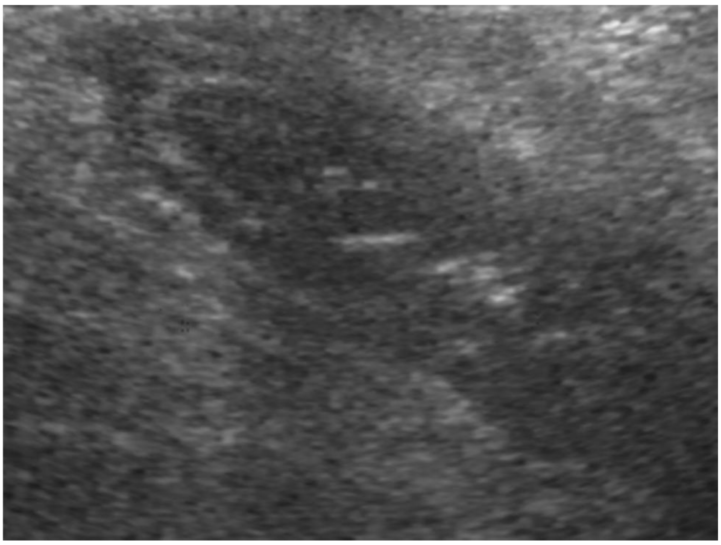


Fig. 4.8.56 Chronic appendicitis, necrotic partial destruction; LAS right

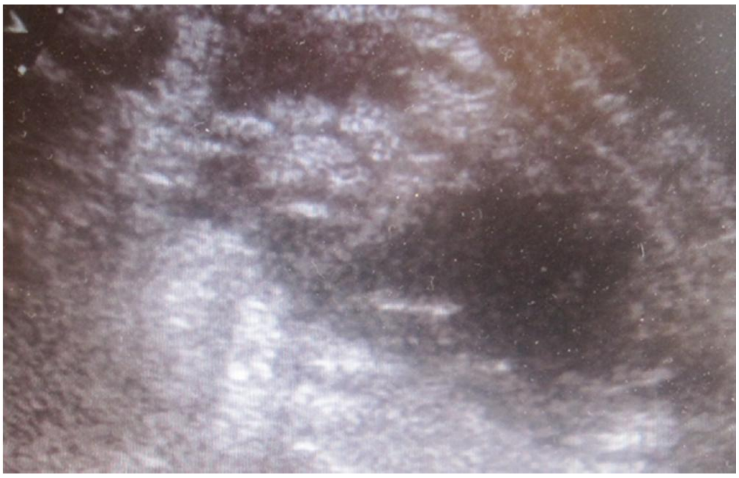


Fig. 4.8.57 Perforating appendicitis; LAS right

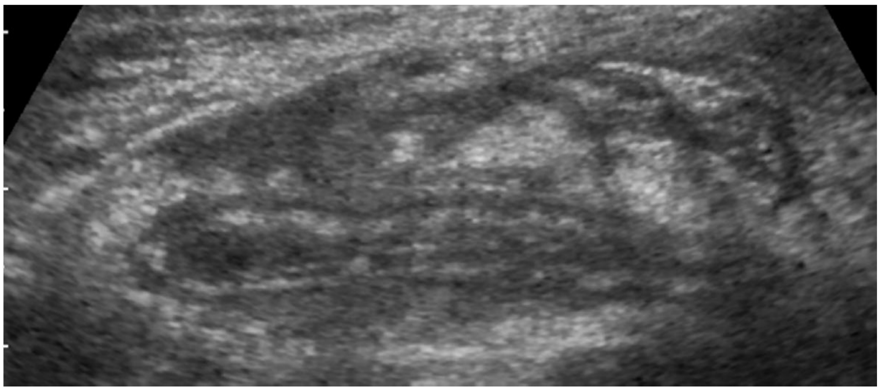


Fig. 4.8.58 Chronic appendicitis with massive surrounding reaction; LAS right

Fig. 4.8.59 Appendiceal stump appendicitis; endoscopic aspect

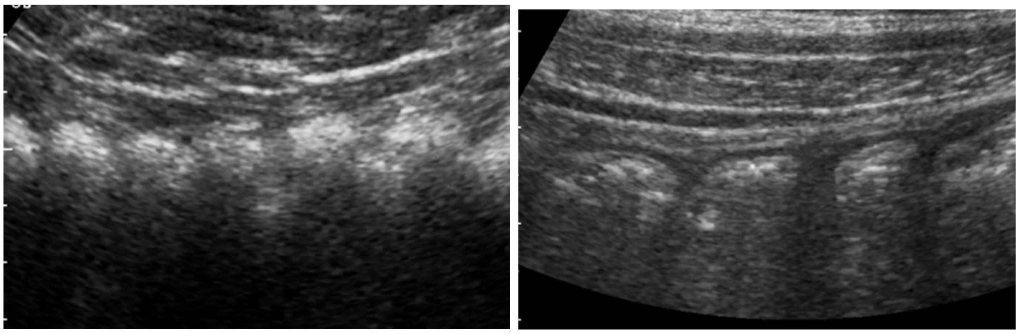


Fig. 4.8.60 a, b Normal (a) and unspecific inflammation (b) of the transverse colon; UAS transverse

Crohn's disease patients prefer ultrasound to endoscopic check-ups (which is not surprising)!

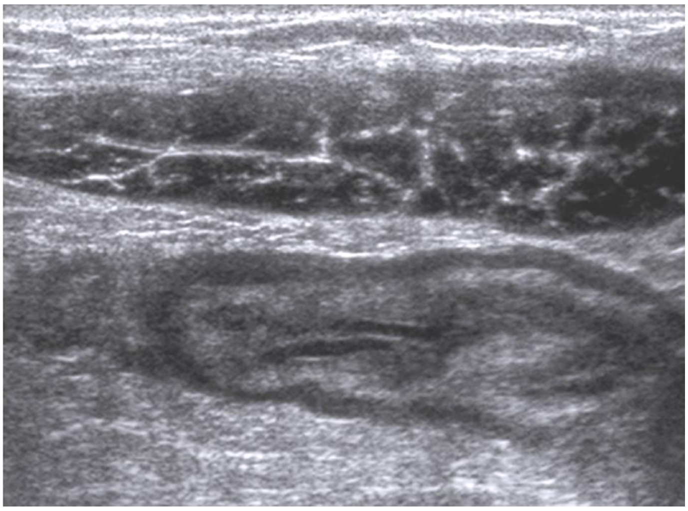


Fig. 4.8.61 Hypertrophied ileum, abdominal wall phlegmons (clinical Crohn's disease); LAS transverse

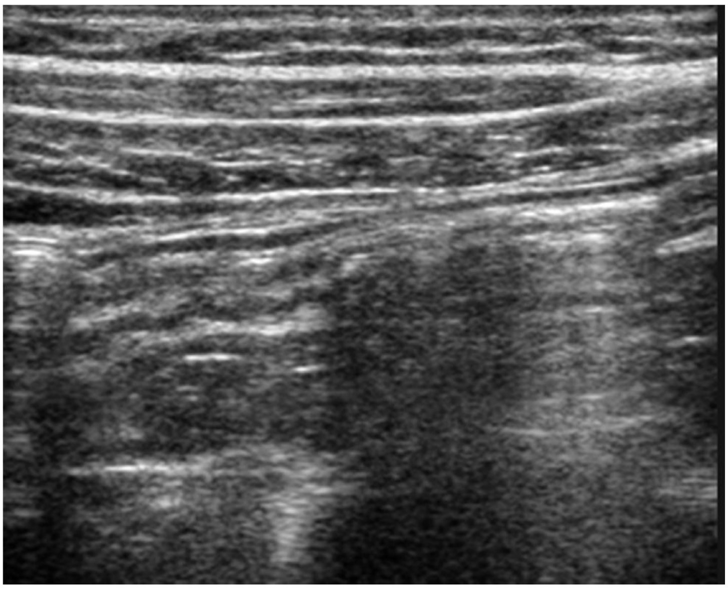


Fig. 4.8.62 Parietal cell destroying and hypertrophying colitis of the descending colon (clinical Crohn's disease), FS transverse

Fig. 4.8.63 Hypertrophied terminal ileum (clinical Crohn's disease); LAS right

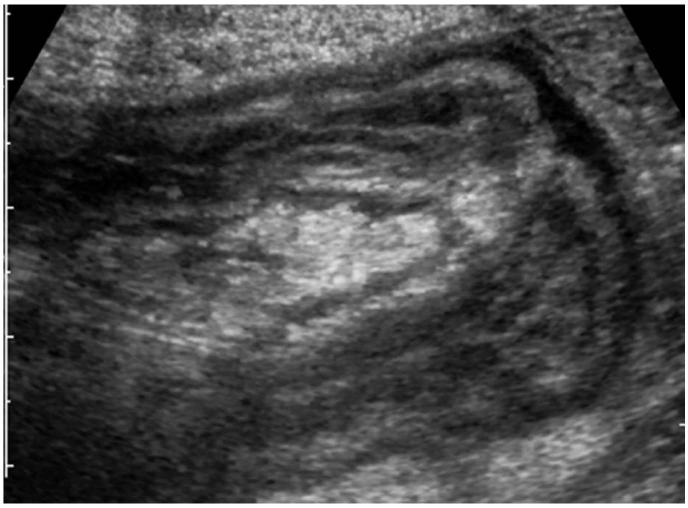


Fig. 4.8.64 Crohn's disease typical transmural small intestinal wall hypertrophy; LAS transverse

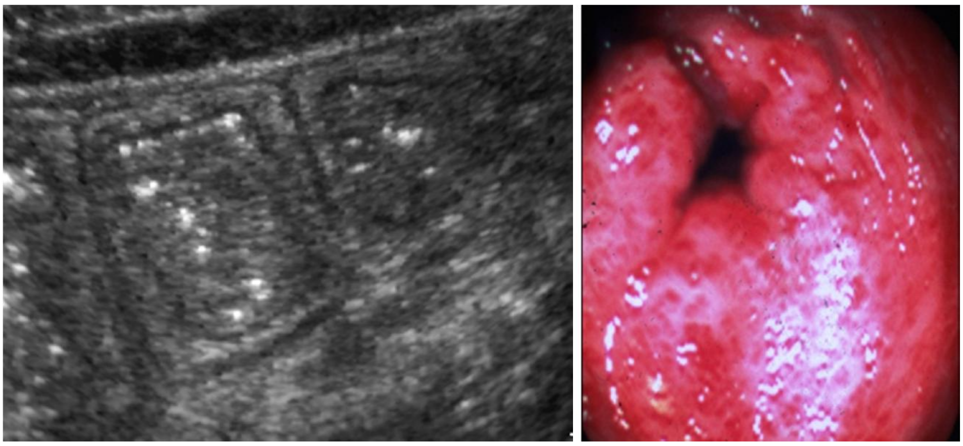


Fig. 4.8.65 a, b Parietal hypertrophying colitis (clinical unspecific enteritis); FS right (a) and endoscopic picture (b)

Fig. 4.8.66 a, b Normal colonoscopic view (a) and orthograde intestinal lavage in the 1970ies (b)

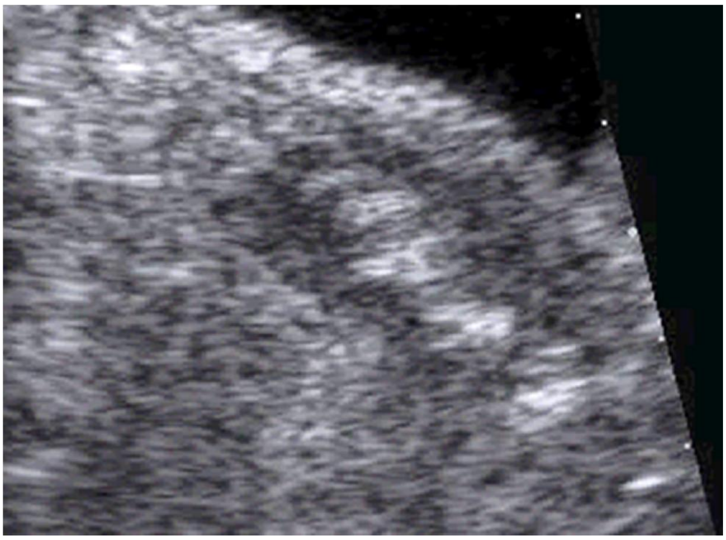


Fig. 4.8.67 Rectal cancer; LAS longitudinal

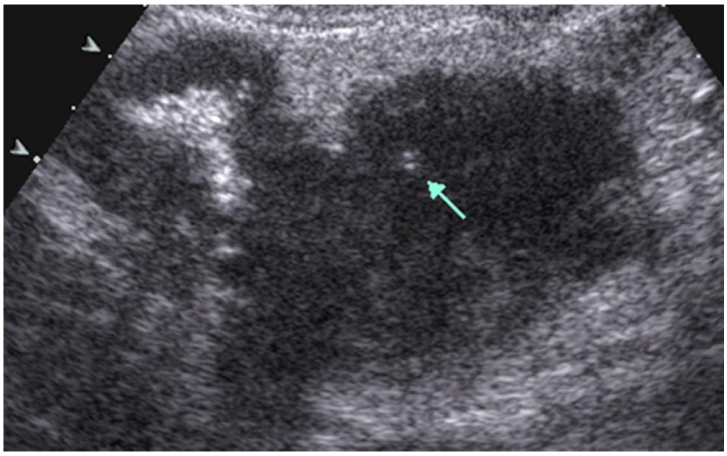


Fig. 4.8.68 a, b Tumour of left flexure (arrow: tip of puncturing fine needle); FS left

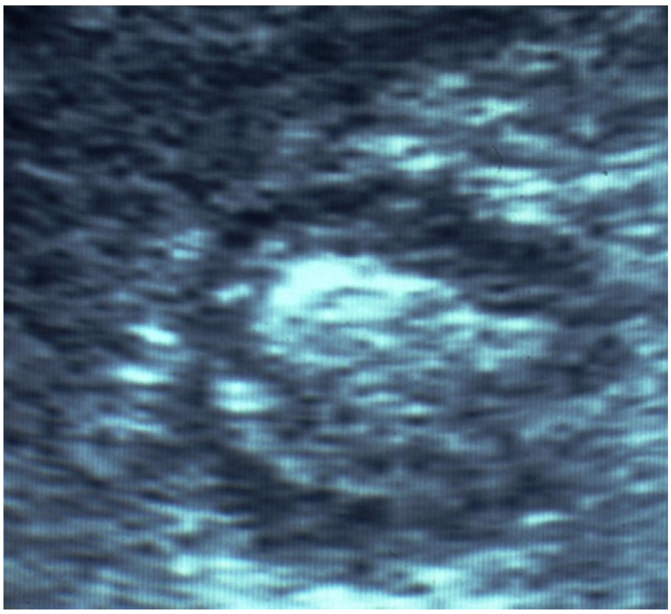


Fig. 4.8.69 Malign partial destruction of antrum; FS right

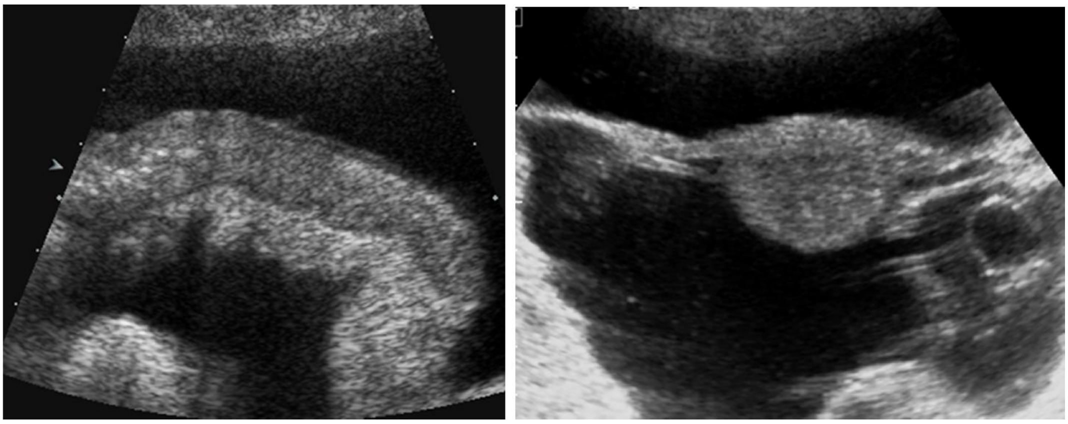


Fig. 4.8.70 a, b Peritoneal carcinosis with hypertrophied small intestinal loop in malign ascites; LAS longitudinal (a) as well as in another case optimized uterus image (b); LAS transverse

Fig. 4.8.71 Ascending colon obstruction with strong peristalsis in tumorous occlusion of left flexure and mistakenly arranged orthograde lavage; FS right

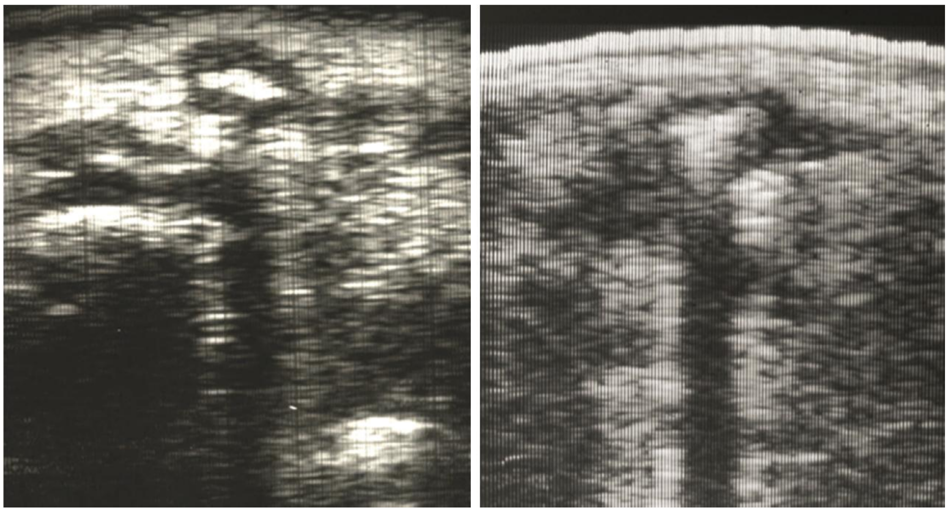


Fig. 4.8.72 a, b With limited technical possibilities (Visodon as sonographic device) in the 1970ies discovered transverse tumour; UAS longitudinal (a, b)

Fig. 4.8.73 Hypertrophied (suspected malignoma with lymph node involvement) ovarian cyst wall, urinary bladder and atrophied uterus normal, as well as rectum; LAS transverse

Fig. 4.8.74 Large ovarian cyst left; slightly filled urinary bladder on right image border; LAS longitudinal

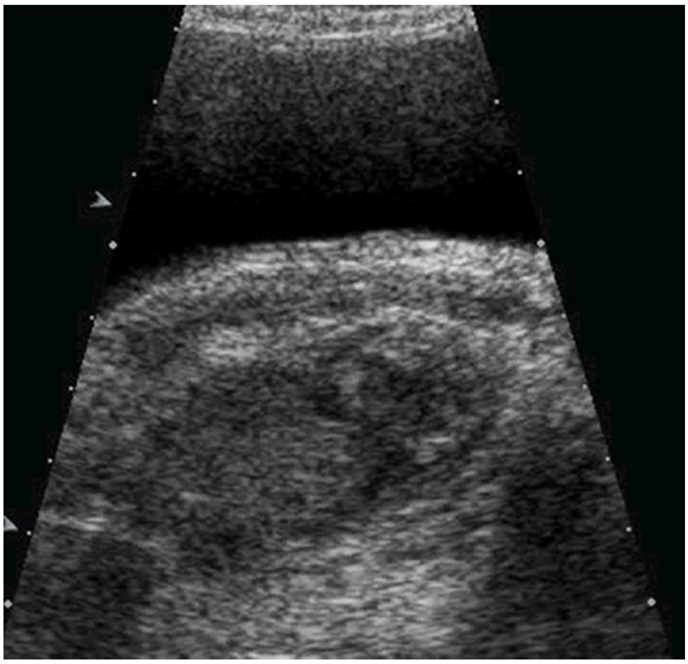


Fig. 4.8.75 Perirectal abscess (clinical Crohn's disease); LAS transverse

Fig. 4.8.76 Myoblastoma of the peritoneum; UAS longitudinal

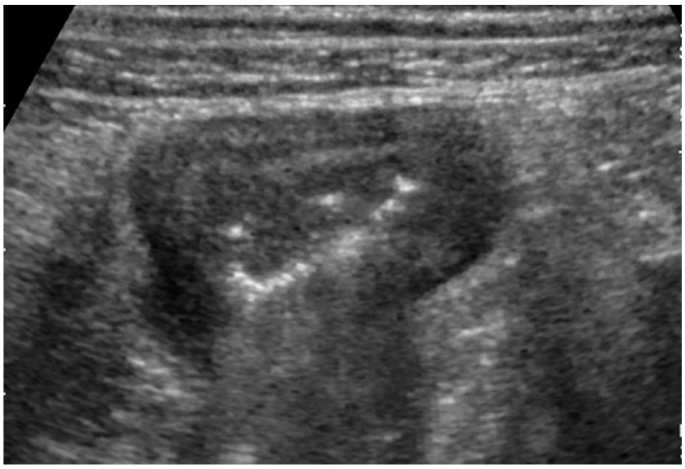


Fig. 4.8.77 Crohn's disease with typical parietal hypertrophy; LAS transverse

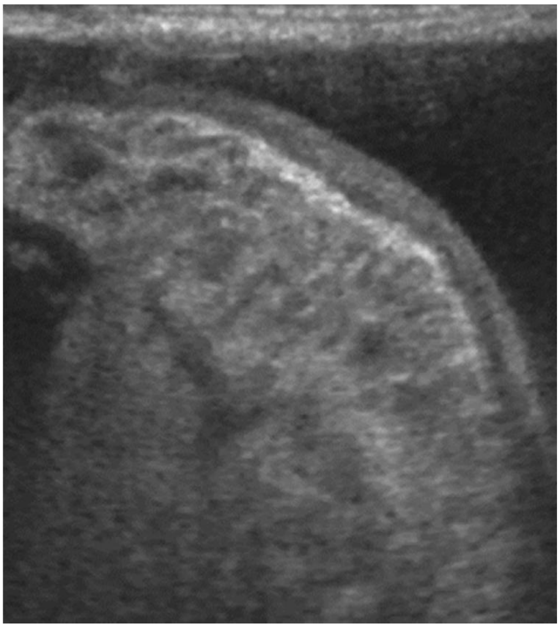


Fig. 4.8.78 Peritoneal carcinosis with small intestinal wall thickening by extensive malign infiltration; LAS transverse

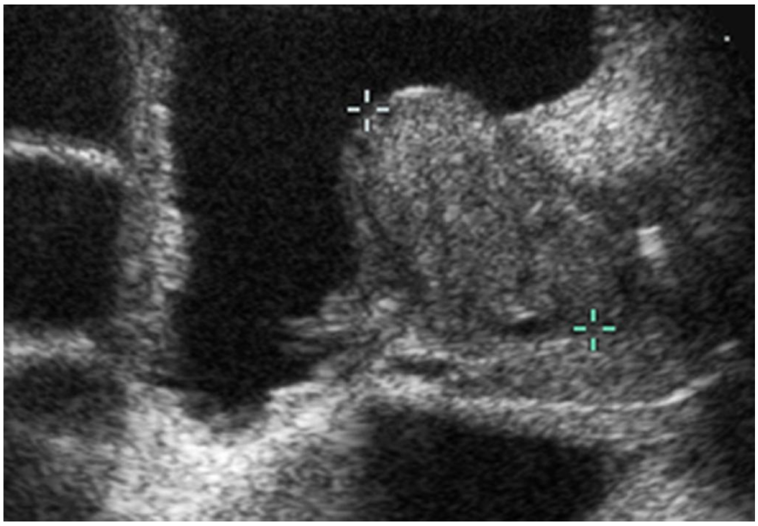


Fig. 4.8.79 Malign tumour infiltrating the small intestinal wall (crosses) with pre-ileus, LAS transverse

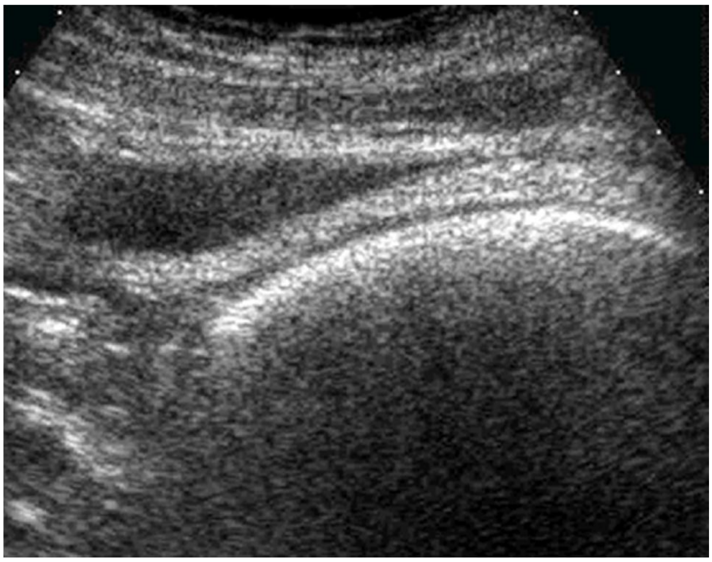


Fig. 4.8.80 Dyschezia; LAS longitudinal


Fig. 4.8.81 Prostate enlargement with elevation of bladder base; LAS transverse

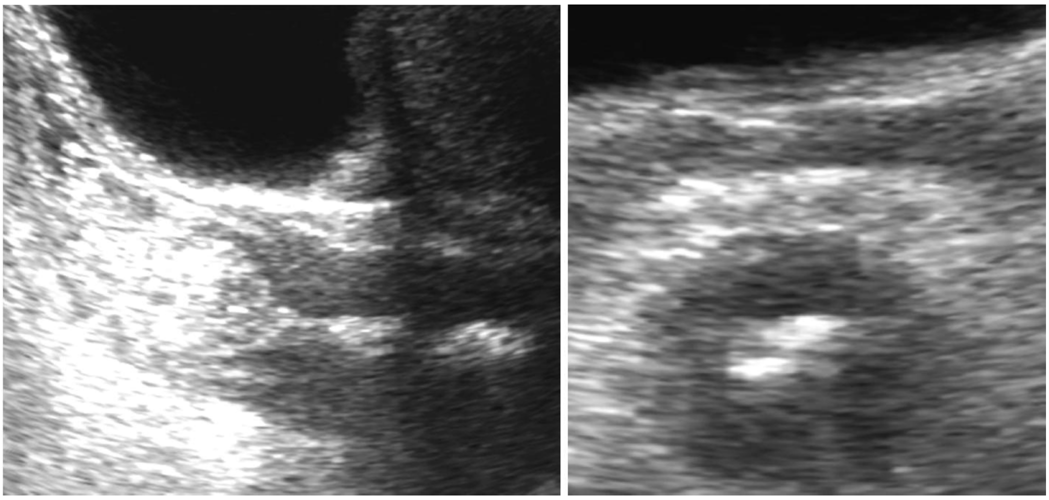


Fig. 4.8.82 a, b	Rectum tumour (clinical cancer); LAS longitudinal (a) and transverse (b)

Please note:

- **intestinal sonography: rewarding and prolific**
- **transcutaneous typical three-layers, endosonographically with entry and exit artefacts five-layered**
- **correlate sonography always with clinical data (and endoscopy)**

4.9 Spleen and Lymph Nodes

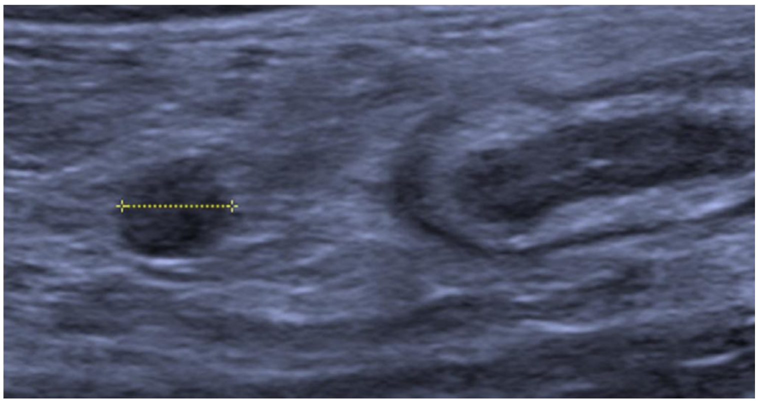


Fig. 4.9.01	Unspecific lymphadenopathy, enteritis; UAS transverse

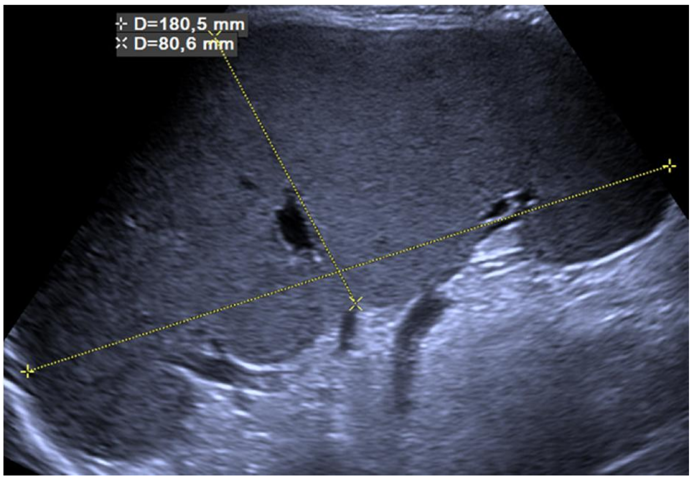


Fig. 4.9.02 Inconspicuous spleen-hilum and normal pancreas tail region; FS left

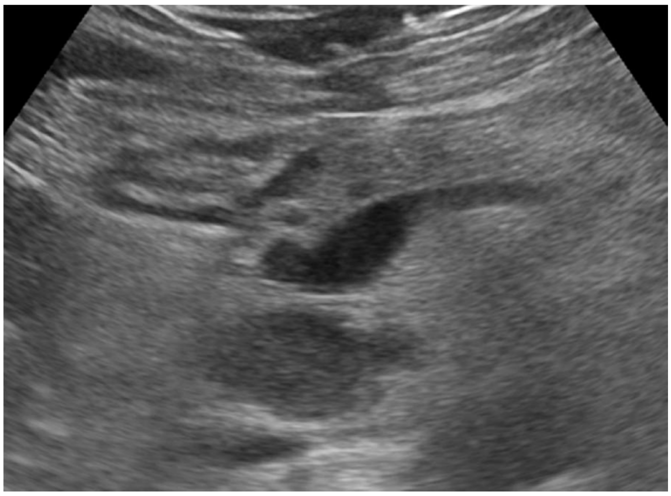


Fig. 4.9.03 Lymphoma (metastatic) close to pancreas head; inconspicuous bulb; UAS transverse

Of the about thousand to thousand five-hundred lymph nodes of the human organism only individual nodes are visible under normal conditions by sonography, for instance at the porta of the liver. This is not true, if they are enlarged and/or reduced echogenic or even pathologically vascularized; they then become significantly better visible. In reference to the special monographs it is here merely noted that lymph node sonography can be really helpful and yield meaningful insights. This is particularly valid for the assessment of benignity or malignity (if it is metastatic in solid tumours or part of haematopoietic illnesses).

Colour duplex and especially contrast medium sonography have opened doors for new and not yet fully utilized scientific possibilities. The few disclosed pictures may suffice to raise the issue.

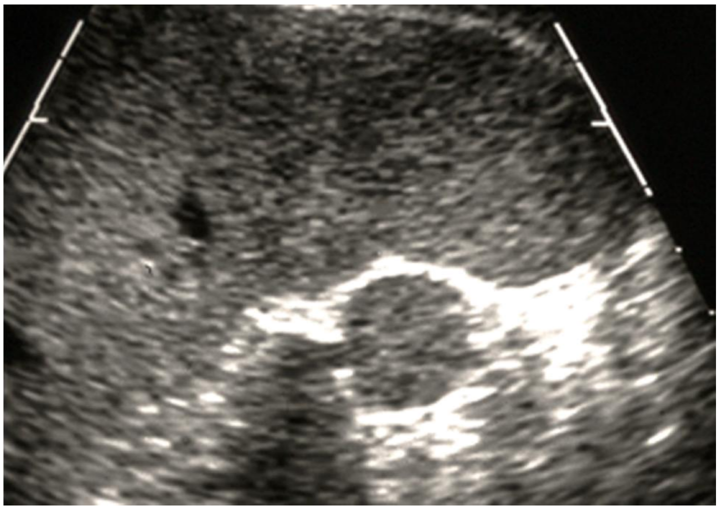


Fig. 4.9.04 Innocuous accessory spleen; FS left

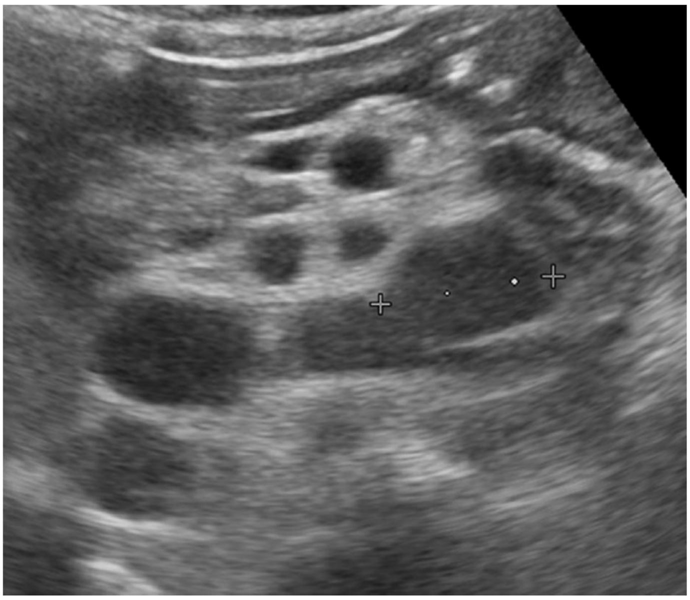


Fig. 4.9.05 Lymphomas and upper abdominal vessels; UAS transverse

Fig. 4.9.06 Lymph node metastases of an ovarian cancer with invasion of inferior vena cava (clinical relative well-being); UAS longitudinal

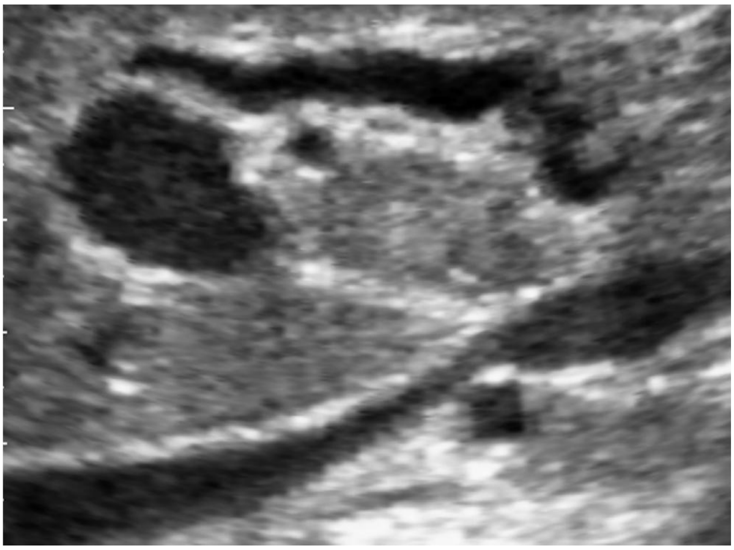


Fig. 4.9.06 Malign lymphadenopathy near liver porta (despite many reflexes) lymphadenopathy; FS right

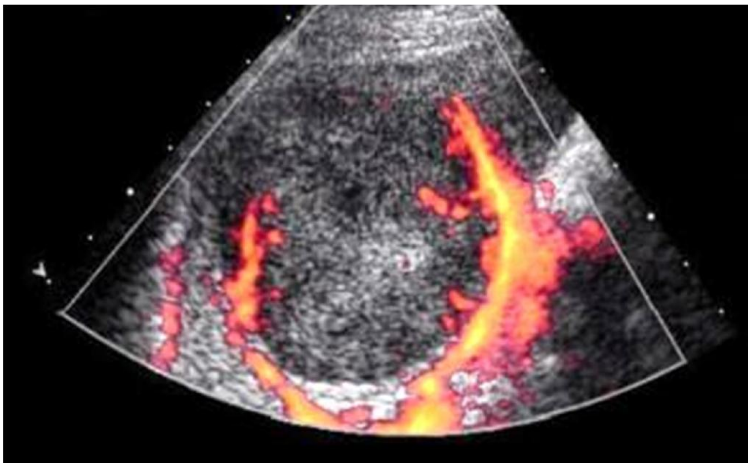


Fig. 4.9.08   Malign spleen tumour; FS right with so-called power Doppler

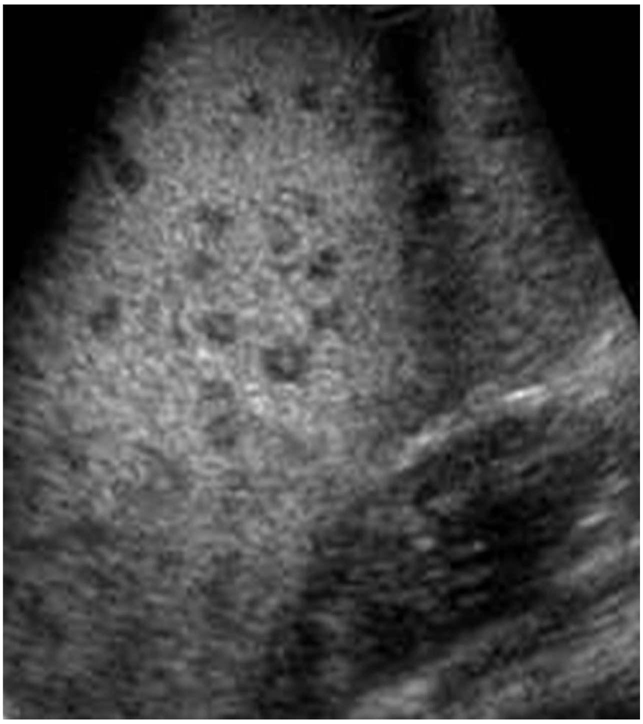


Fig. 4.9.09   Lymphoma infiltration of the spleen with hypoechoic FL, kidney truncated; FS left

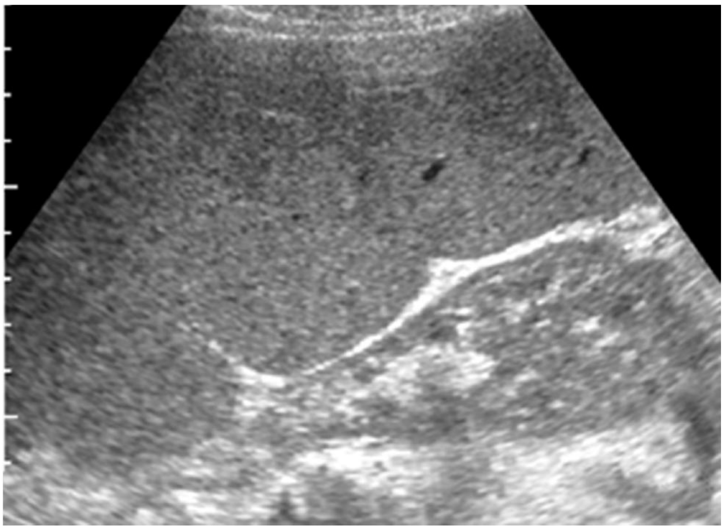


Fig. 4.9.10 Splenomegaly with compression of left kidney; FS right

Fig. 4.9.11 Lymphadenopathy (clinical sarcoidosis) in the liver porta, vena cava and segment I inconspicuous; FS right

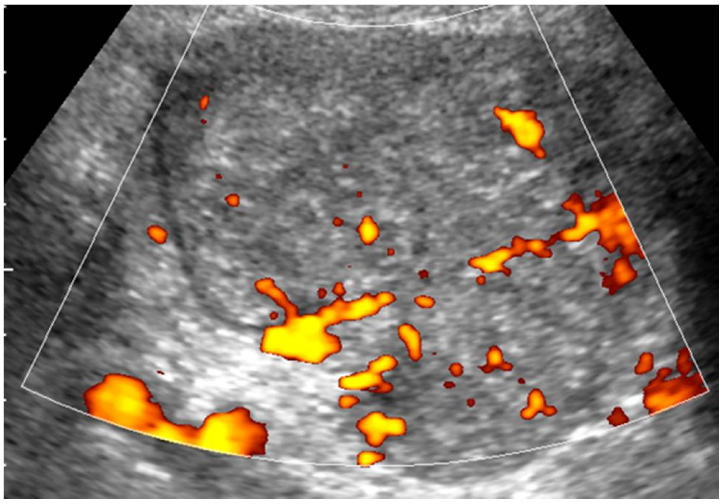


Fig. 4.9.12 Malignoma infiltrated lymph node with pathological vessels; cervical soft tissue right (with CCDS)

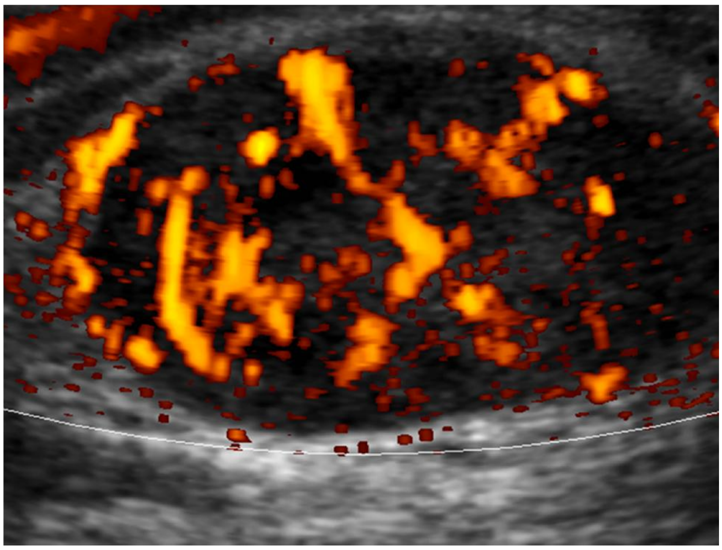


Fig. 4.9.13 Strong suspicion of lymph node malignoma with pathological vessels; right inguinal sections (with so-called power mode sonography)

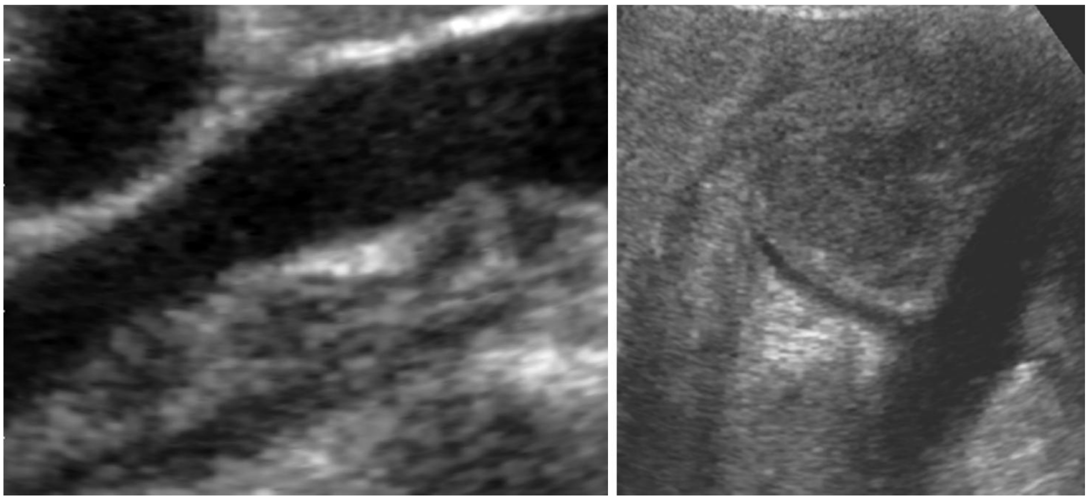


Fig. 4.9.14 a, b Retro-aortic lymphadenopathy, as well as truncated section of diaphragm crus, and in another case, malign lymphadenopathy with dislocation of superior mesenteric artery; UAS longitudinal

Fig. 4.9.15 Probably malign sub-hepatic lymphadenopathy; FS right

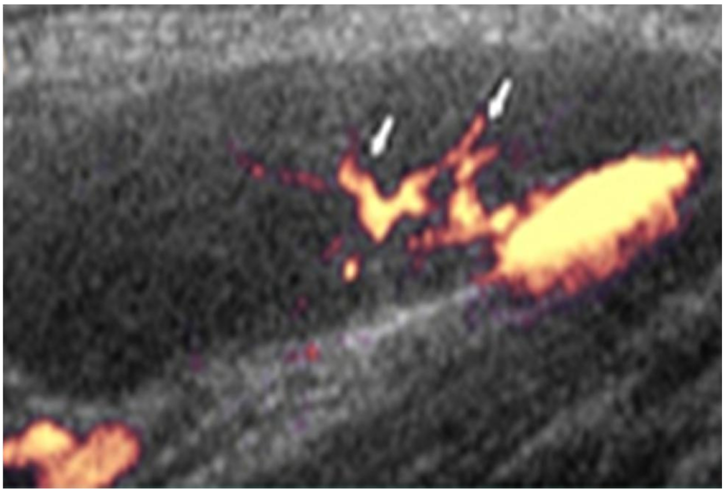


Fig. 4.9.16 Probably malign lymphadenopathy; sections longitudinally of left armpit (with colour-coded so-called power mode sonography)

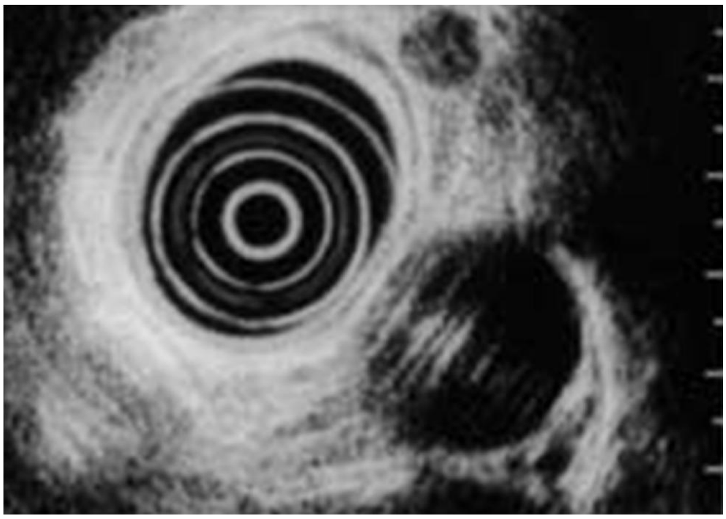


Fig. 4.9.17 Endosonography with lymphadenopathy (clinical metastasizing bronchial cancer), normal thoracic aorta

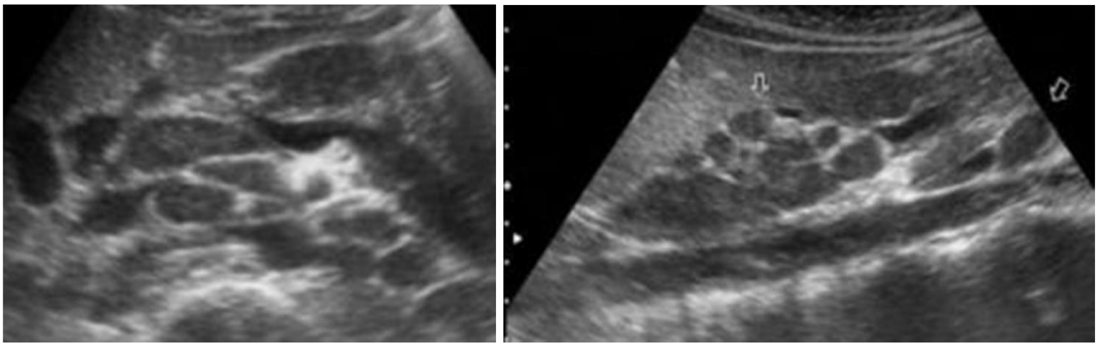


Fig. 4.9.18 a, b Probably malign lymphoma, normal pancreas; UAS longitudinal (a) and transverse (b)

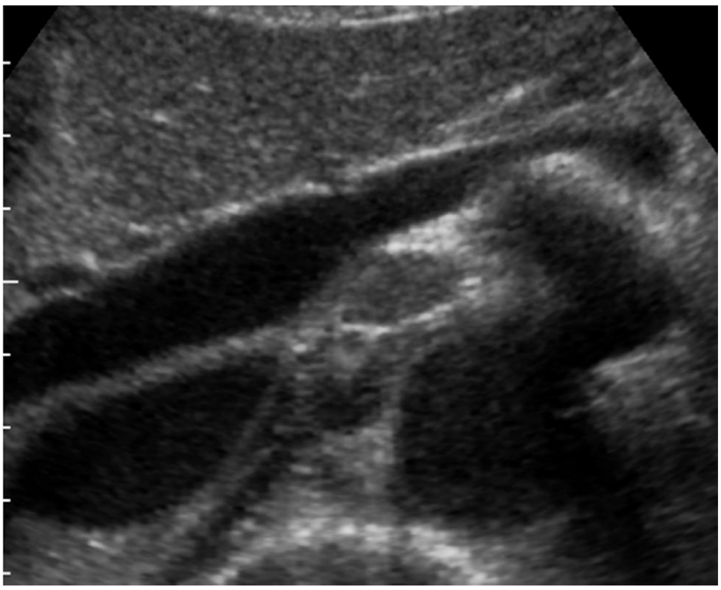


Fig. 4.9.19 Cancer of unknown primary origin (CUP) syndrome with lymphoma in aorta vicinity; UAS transverse

Fig. 4.9.20 Sarcoidosis, inconspicuous antrum; UAS transverse

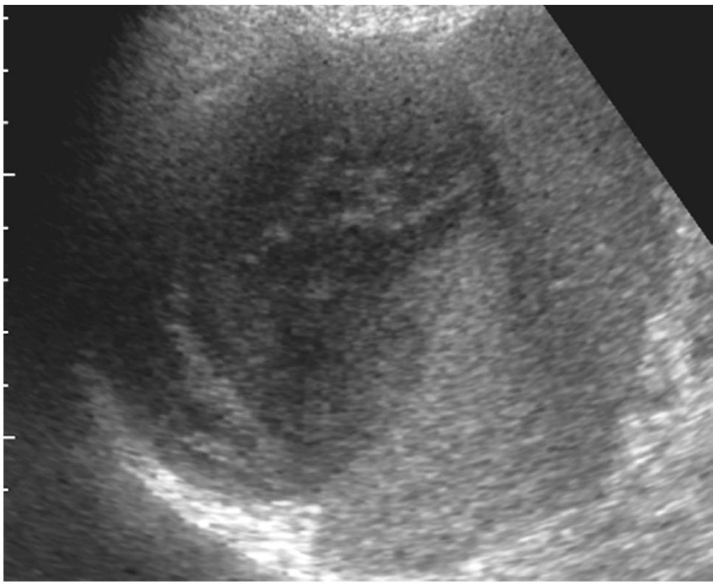


Fig. 4.9.21 Clearly defined (probably benign) large spleen cyst; FS left

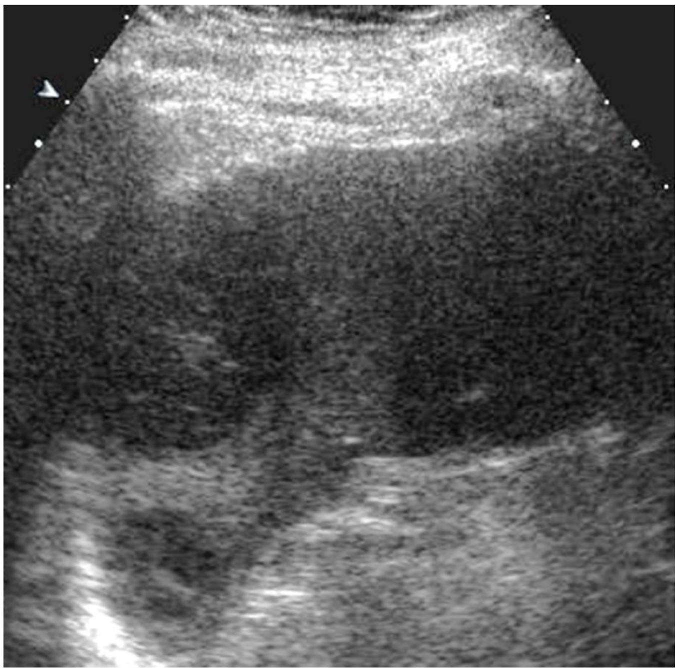


Fig. 4.9.22 Not clearly defined (most likely malign) spleen cysts (from the time before CM availability); FS left

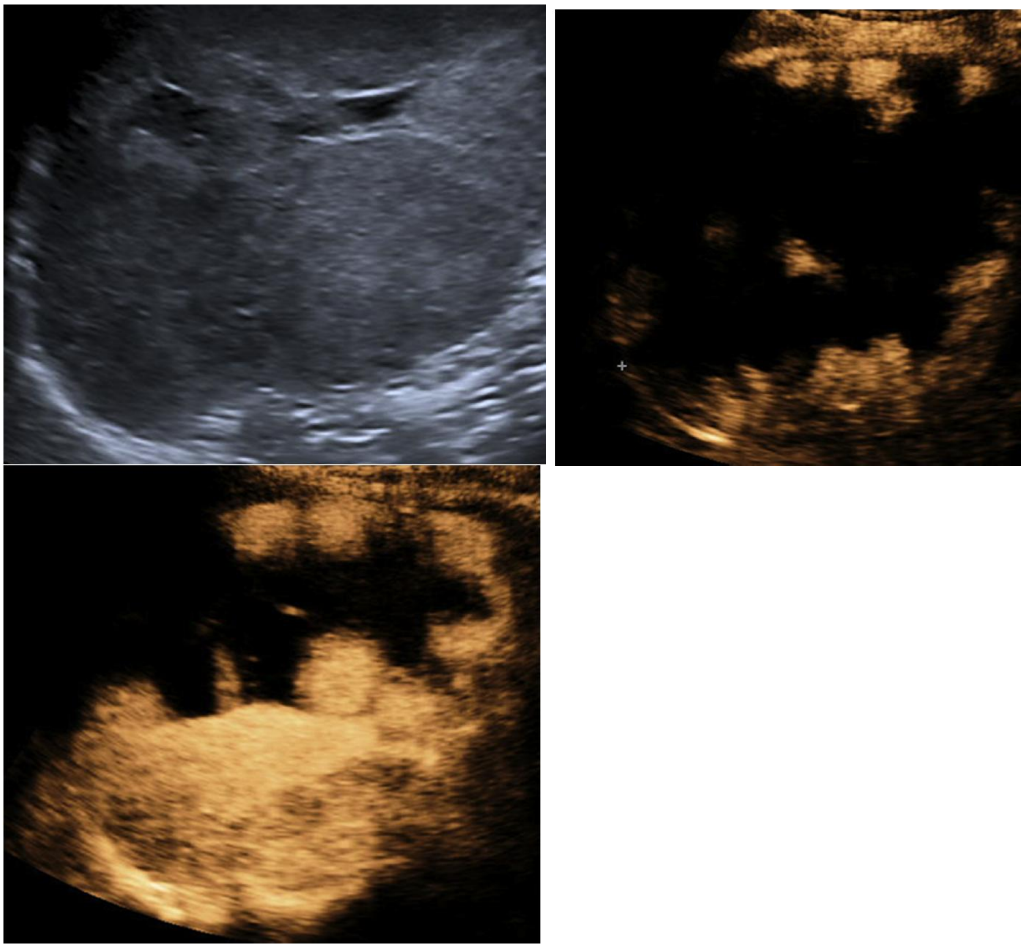


Fig. 4.9.23 a-c Probably large spleen haematoma; FS left (b, c with CM)

Fig. 4.9.24 Post-traumatic splenic rupture; FS left

4.10 Emergency Sonography

Emergency sonography puts very high demands on the examiner, from which he/she should not be deterred to conduct the sonographic initial examination (more must follow). Besides the numerous normal findings, which also contain information, many cases are expected to be conclusive or have at least a probable diagnoses in answering clinical questions, which cannot be described in detail (we kindly refer to more competent monographs). Furthermore, in many cases the CT can be done without, which is appreciated especially in younger patients to avoid radiation exposure. According to the American Society of Radiology, every 50th CT induces a malignoma.

After all, it should be taken into account that emergency sonography deals with specific circumstances regarding examination condition obstacles. This can involve the unfamiliar or even unknown device as well as limited knowledge of the medical history, unfavourable lighting and positioning, and the lack of trained assistance (which is particularly of consequence in necessary CM examinations and interventional sonographic steps).

Nevertheless, the first sectional image of the abdomen, thorax, or extremities can give flash point diagnostic evidence, which can be demonstrated by random individual examples.

Fig. 4.10.01 Urinoma (clinical sudden side pain); FS right

Fig. 4.10.02 a, b Shock-induced necrosis of the hepatic bile duct with endoscopic material extracted after EPT (a); ERCP (b)

The combination of clinical and sonographic findings is emphasized at this point again, also the possibly given necessity for unusual section patterns and the deduction abilities of the examiner, generally the physician in charge.

Fig. 4.10.03 "Spontaneously" developed haematoma (with Marcumar treatment, several hours acute upper abdominal pain, no indication for puncture!); UAS longitudinal

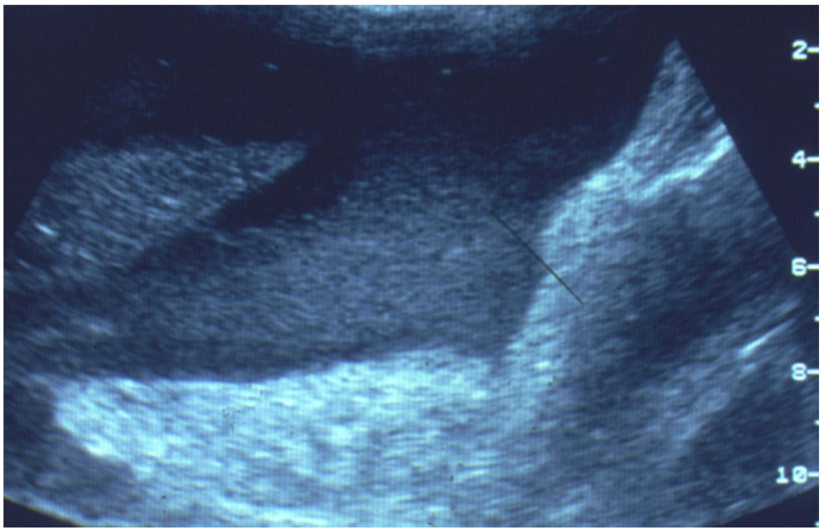


Fig. 4.10.04 Echogenic (clinical infected) ascites; LAS longitudinal

Fig. 4.10.05 Portal gas (clinical status after colon surgery in the (static!) CT typically misinterpreted as aerobilia); FS right

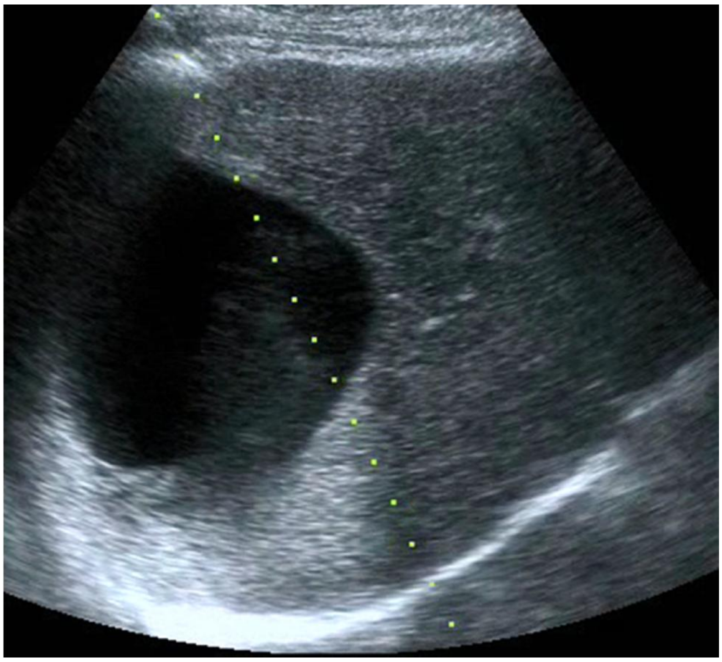


Fig. 4.10.06 Post-puncture haemorrhage in the liver; SCS

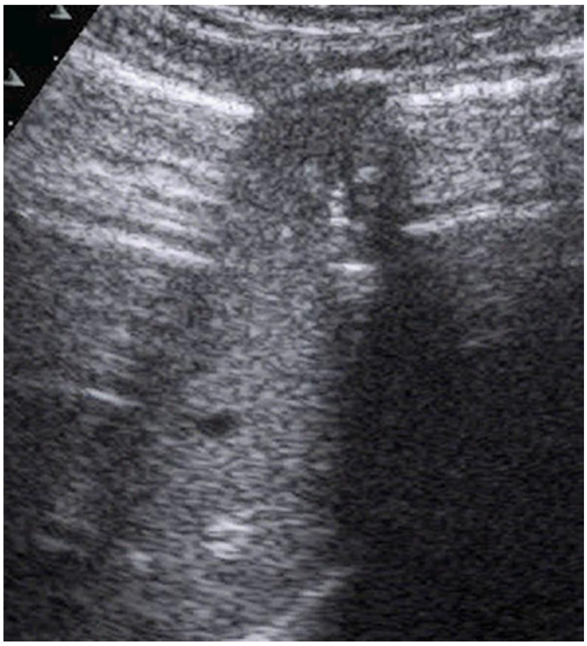


Fig. 4.10.07 Free (image left) and intestinally trapped (right image side) gas (namely "air") with typical reverberation artefacts, liver partially superimposed; UAS longitudinal

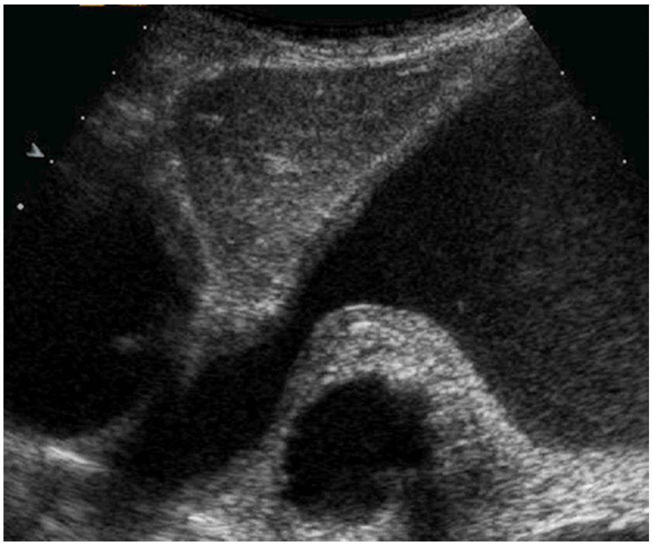


Fig. 4.10.08 Retention stomach, abdominal aorta, normal liver; UAS transverse

Please note:

- ***always act with clinical ultrasonography***
- ***correlate with clinical findings***
- ***use also unusual section patterns and regions***

4.11 Colour-Coded Duplex and Contrast Medium Sonography

The coding of flow direction and intensity by different colours - shades of red for flow towards the transducer, shades of blue away from transducer - represents one of the most successful improvements of real-time sonography; its development was done predominantly in former East Germany (ref. Wermke). Individual monographs dedicated to it are certainly justified. At this point it is to be only emphasized that it virtually belongs to the daily equipment, and that it is part of the obvious integrated scope of sonography education, both regarding anatomic orientation and differential diagnosis.

"Colour" is consequently - to emphasize this again - a normal, simple add-on of sonographic real-time examination; and although it requires particular expertise, it should be available to the beginner from the start, for whom it is at the same time a teaching and learning experience.

The same considerations hold true analogously for CM sonography. The artificial intravenous administration of ultrasound CM - the last genuine innovation in real-time sonography - should also be used frequently from the beginning of examination activities, and indicated liberally. And it should be a matter of course of real-time sonography. It is a fact that CM sonography has to be specifically taught and learned, and that it has its own requirements.

Please note:

- ***keep in mind and use generously***
- ***often clarifying from an anatomical point of view***
- ***learn and teach concomitantly to B-picture sonography***
- ***use correct device settings***

4.12 Thorax

It should always be remembered - small pleural effusions are thus easily discovered in a sitting position, or when the examined person stands up, or real lesions are to be differentiated from pseudo-lesions.

In every case thorax and lungs are to be included in the sonographic examination when there is the respective clinical evidence. Not without reason are details concerning this dealt with in their own monographs; so that at this point it is only summarily referred to the sonography of the thorax and lungs, as well as the mediastinum (which is known to be sonographically excellently accessible).

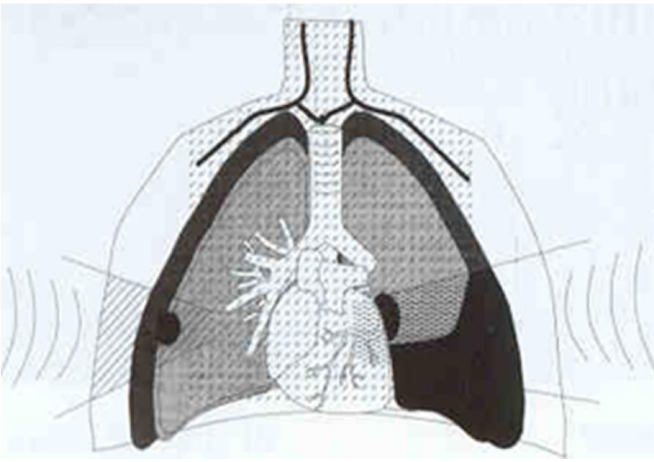


Fig. 4.12.01 Schematic representation of possibilities for thoracal sonography: lung tumour (pleural) right, effusion, and another, then visible by the atelectasis and its effusion, pulmonary tumour in sitting examination position from dorsal or lateral.

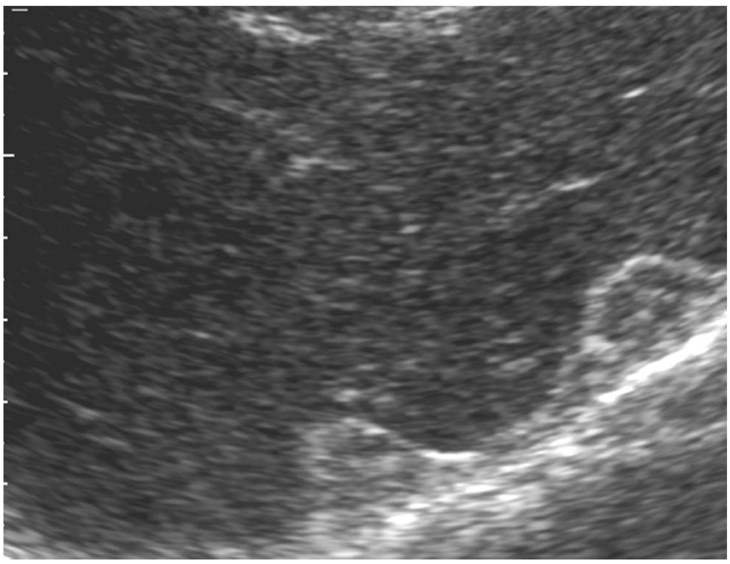


Fig. 4.12.02 Diaphragm crus, no real FL; FS right

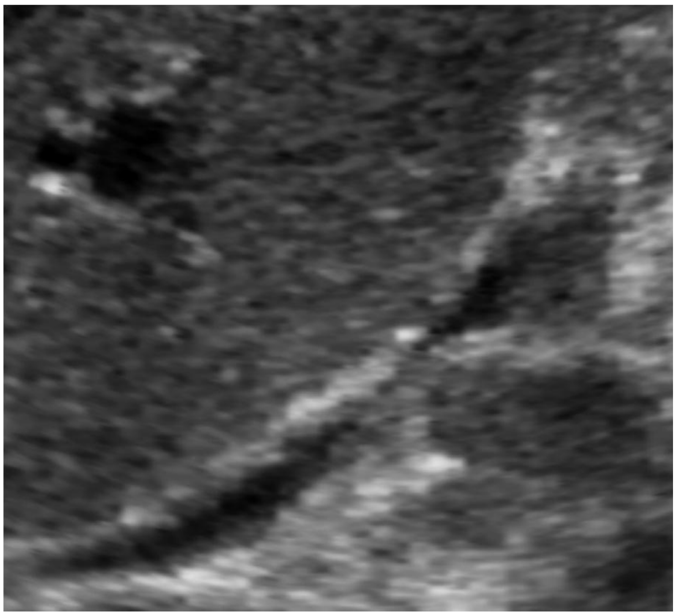


Fig. 4.12.03 Small pleural effusion while sitting, truncated diaphragm sections with liver tightly attached; FS right

Fig. 4.12.04 Examination of dorsal lung sections while sitting (intercostal cross sections were used here, also longitudinal sections are possible)

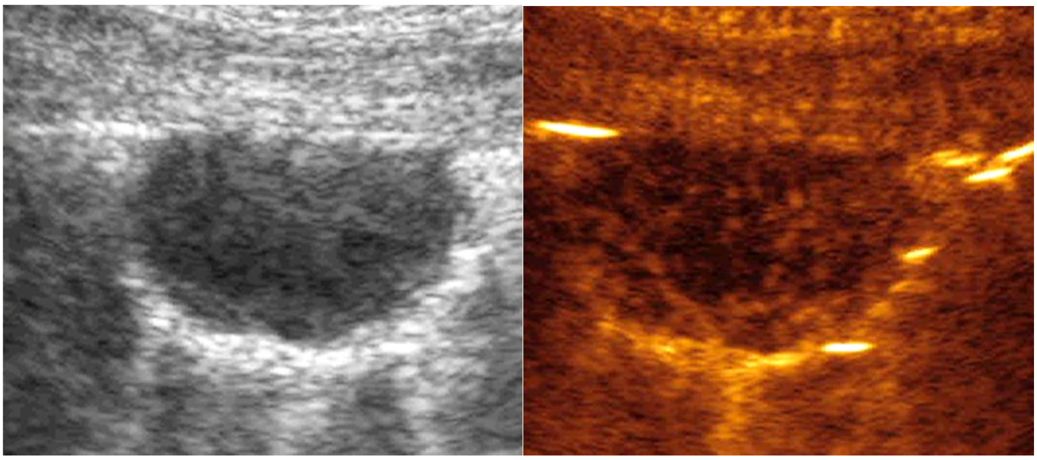


Fig. 4.12.05 a, b Small peripheral lung tumour (clinical bronchial cancer); intercostal thoracal sections, CM in left image half)

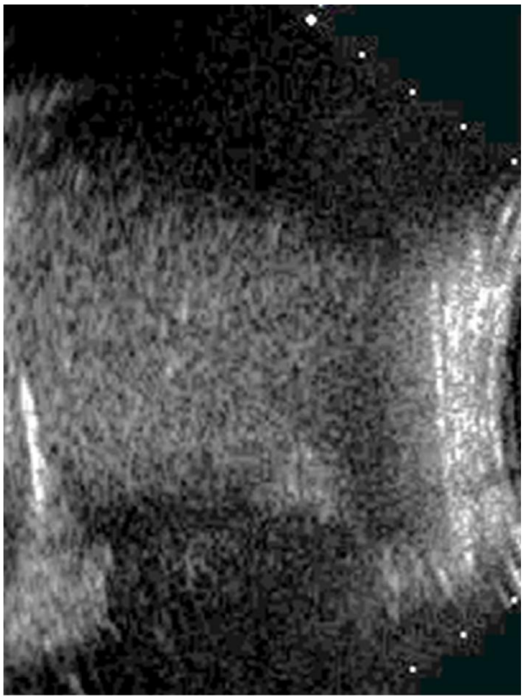


Fig. 4.12.06 Lung tumour and pleural effusion (containing echogenic detritus); ICS

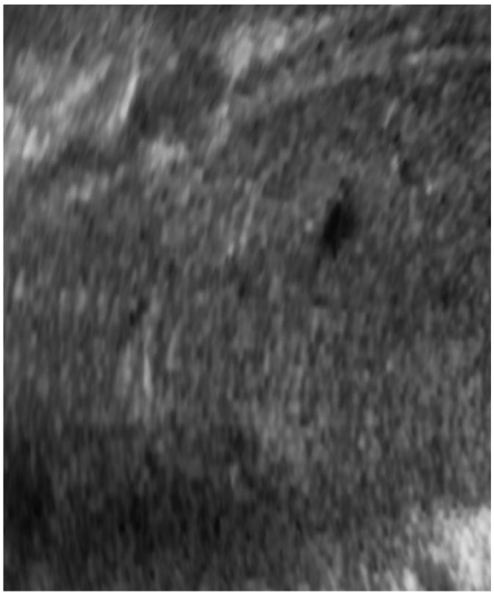


Fig. 4.12.07 Real pleural-diaphragm space occupational nodular lesion without effusion (clinically known metastasizing bronchial cancer); FS right transsplenic

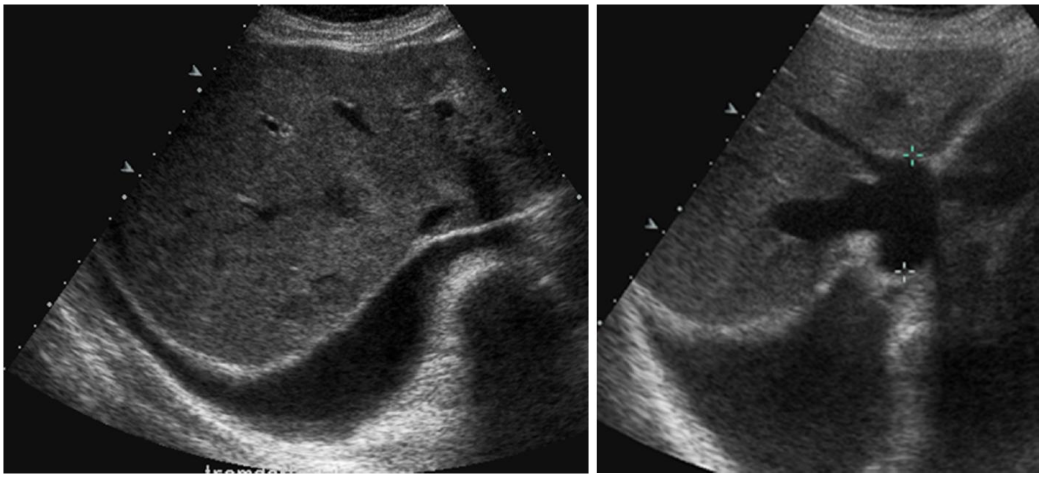


Fig. 4.12.08 a, b Small (a) and, in another case, moderate (b) pleural effusion right, FL (a probably metastases) (clinically known bronchial cancer) (b cardiac congestion with congestion of inferior vena cava, measurement crosses); SCS right (a), thoracal sections (b); intercostal

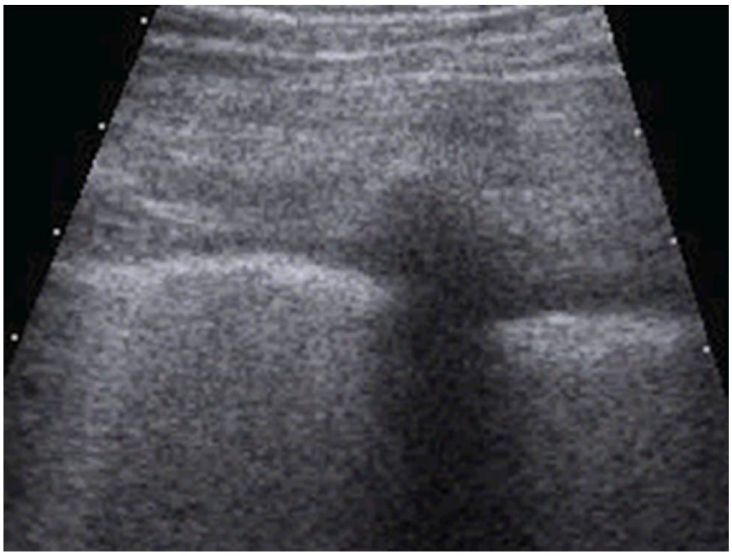


Fig. 4.12.09 Small pleural effusion (clinical bronchial cancer), costal sound shadow; LS

Fig. 4.12.10 Pleural mesothelioma with effusion, normal liver; ICS right

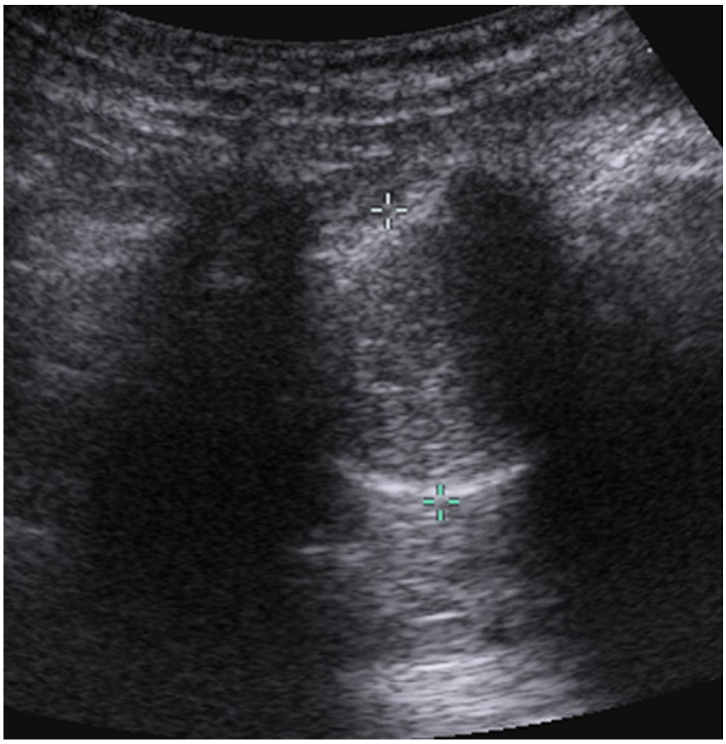


Fig. 4.12.11 Parietal lung tumour (clinical bronchial cancer); thoracal sections right

Please note:

- ***rewarding in respective clinical indication***
- ***well combinable with endoscopy (endobronchial ultrasonography EBUS)***

4.13 Interventional Sonography

Sonography guided puncture, justifiably so, is also addressed in monographs (ref.). In 2% of the examinations this is necessary, whereby the percentage has been decreasing steadily in the last years thanks to colour coding and CM sonography, and thanks to increasing acceptance of high probability diagnoses (forgoing microscopic confirmation). At a higher indication threshold and minimal residual risk of injury and tumour cell spreading, coherent indication and adequate examination technology are of importance.

The shortest puncture distance is as a rule, but not entirely without exceptions, the best and has the lowest risk.

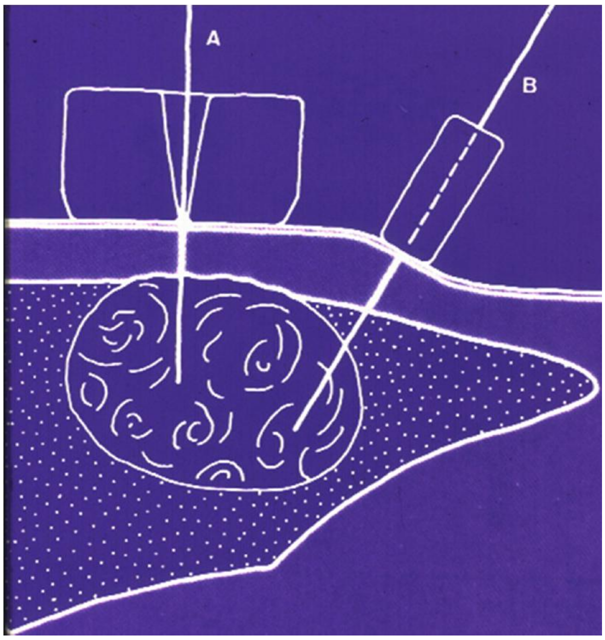


Fig. 4.13.01 Direct straight puncture is unfavourable because of vulnerable FL, acceptance of lower risk by longer puncture distance.

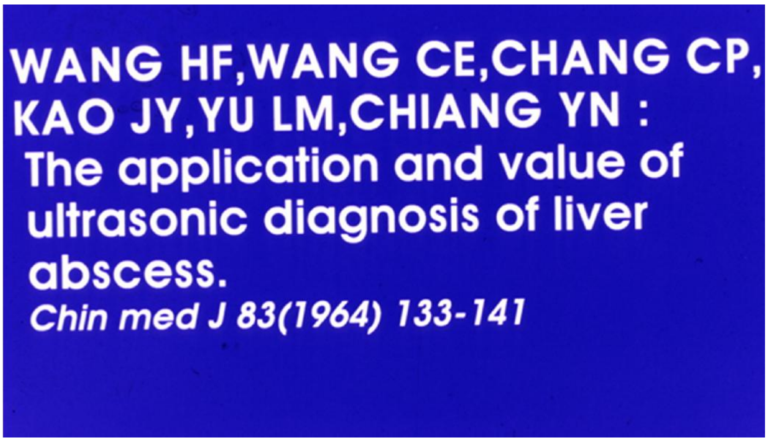


Fig. 4.13.02 First sonography guided puncture publication

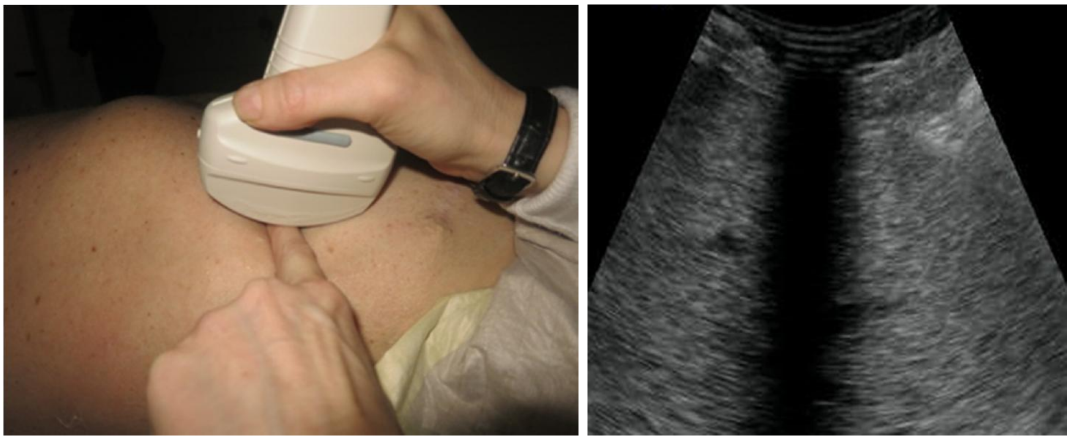


Fig. 4.13.03 a, b FS right and sound shadow (b) evoked by finger (a) for the conduct of sonography assisted liver puncture (SALP)

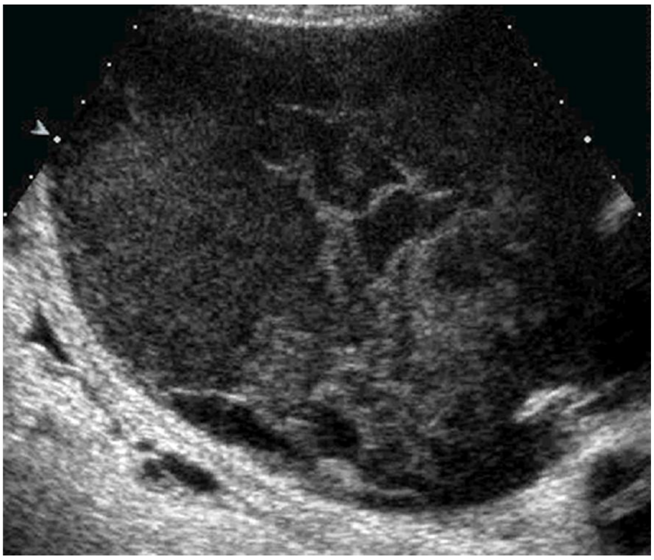


Fig. 4.13.04 Large Hb-effective abdominal wall haematoma with intestinal loop compression and minimal ascites, truncated section of left external iliac artery, clinical condition after fine needle puncture of ascites, conservative healing; LAS transverse

Fig. 4.13.05 Unusual cystic pancreas head lesion developed after barotrauma (gunshot wound in red-light district) (wait-and-see treatment, no surgery, no US puncture); UAS transverse

Puncture serves mostly diagnostic purposes and less frequently therapeutic objectives, such as for instance confirmation puncture with little (!) material extraction prior to a planned drainage.

The presence and support of an experienced nurse or physician is necessary, also from a forensic point of view.

Fig. 4.13.06 Endosonography device supplied with drainage catheter

Fig. 4.13.07 Elaborate puncture CT

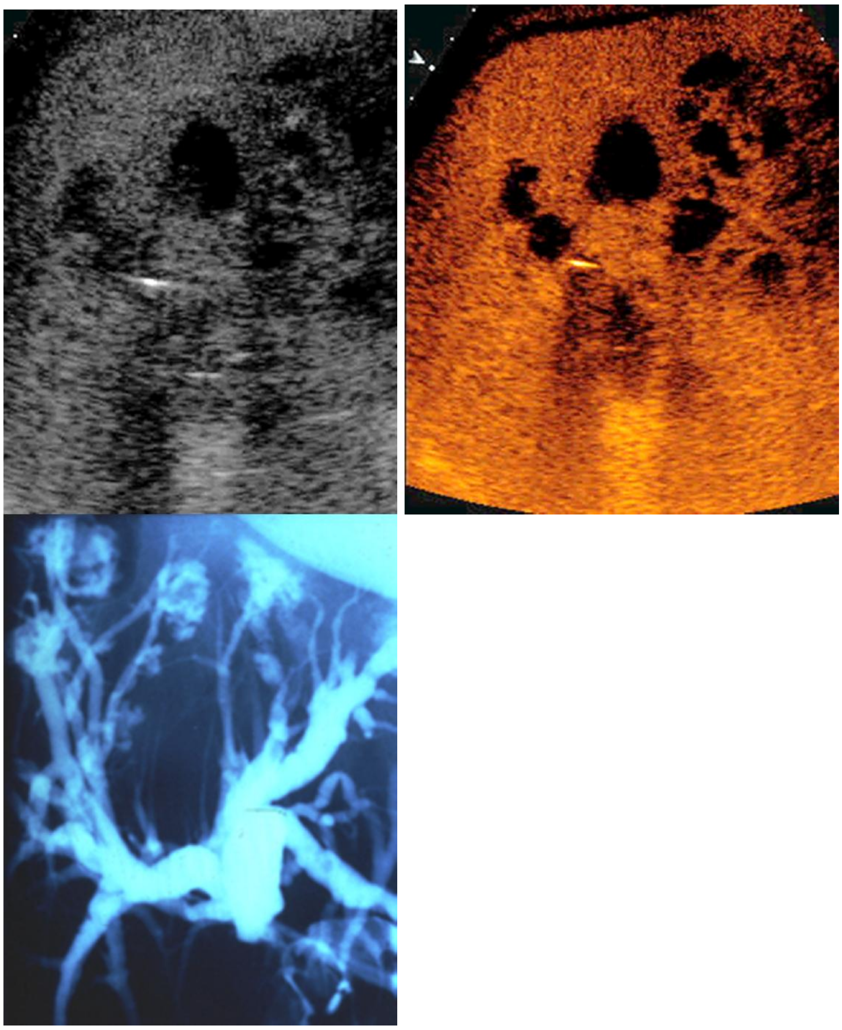


Fig. 4.13.08 a-c Hepatic abscesses; subcostal diagonal sections (a with CM, c ERCP) (different cases); SCS right

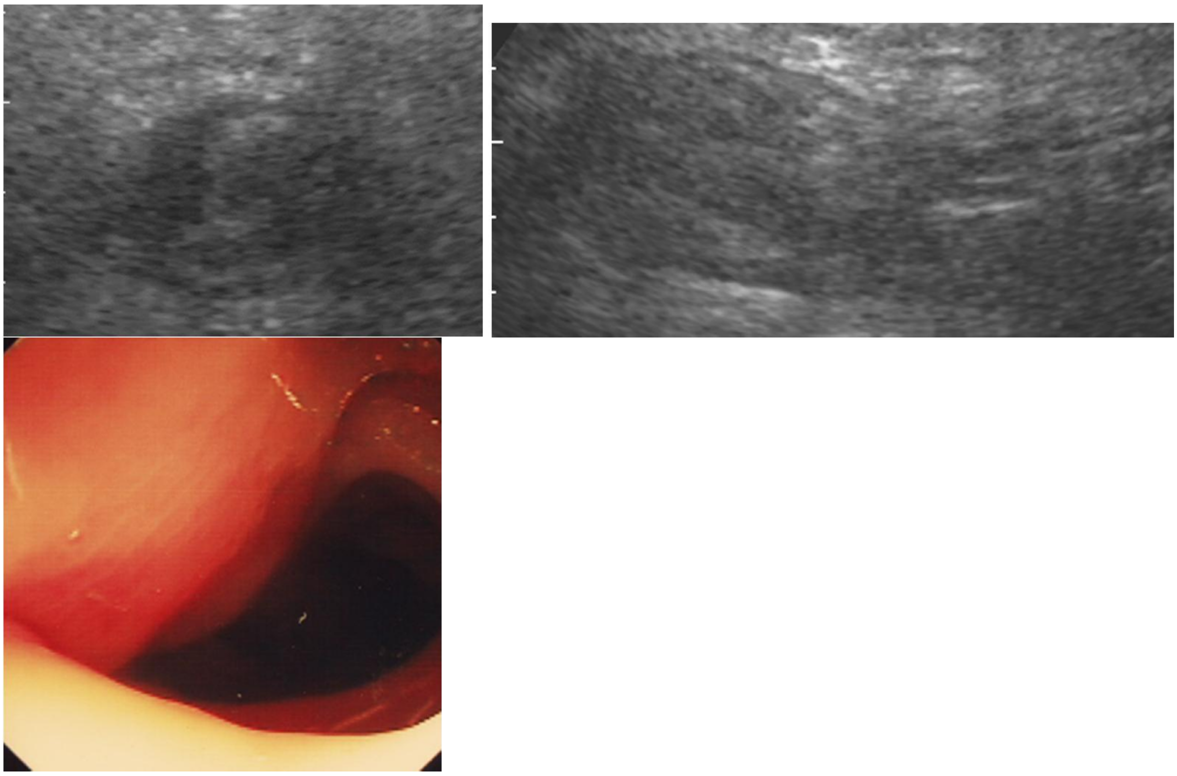


Fig. 4.13.09 a-c Another case of intestinal wall phlegmon; LAS longitudinal (a and b), and colonoscopy

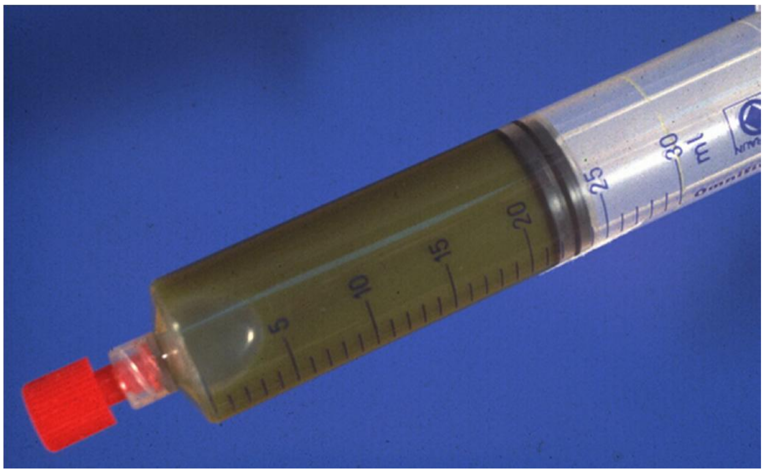


Fig. 4.13.10 Aspiration material from liver abscess

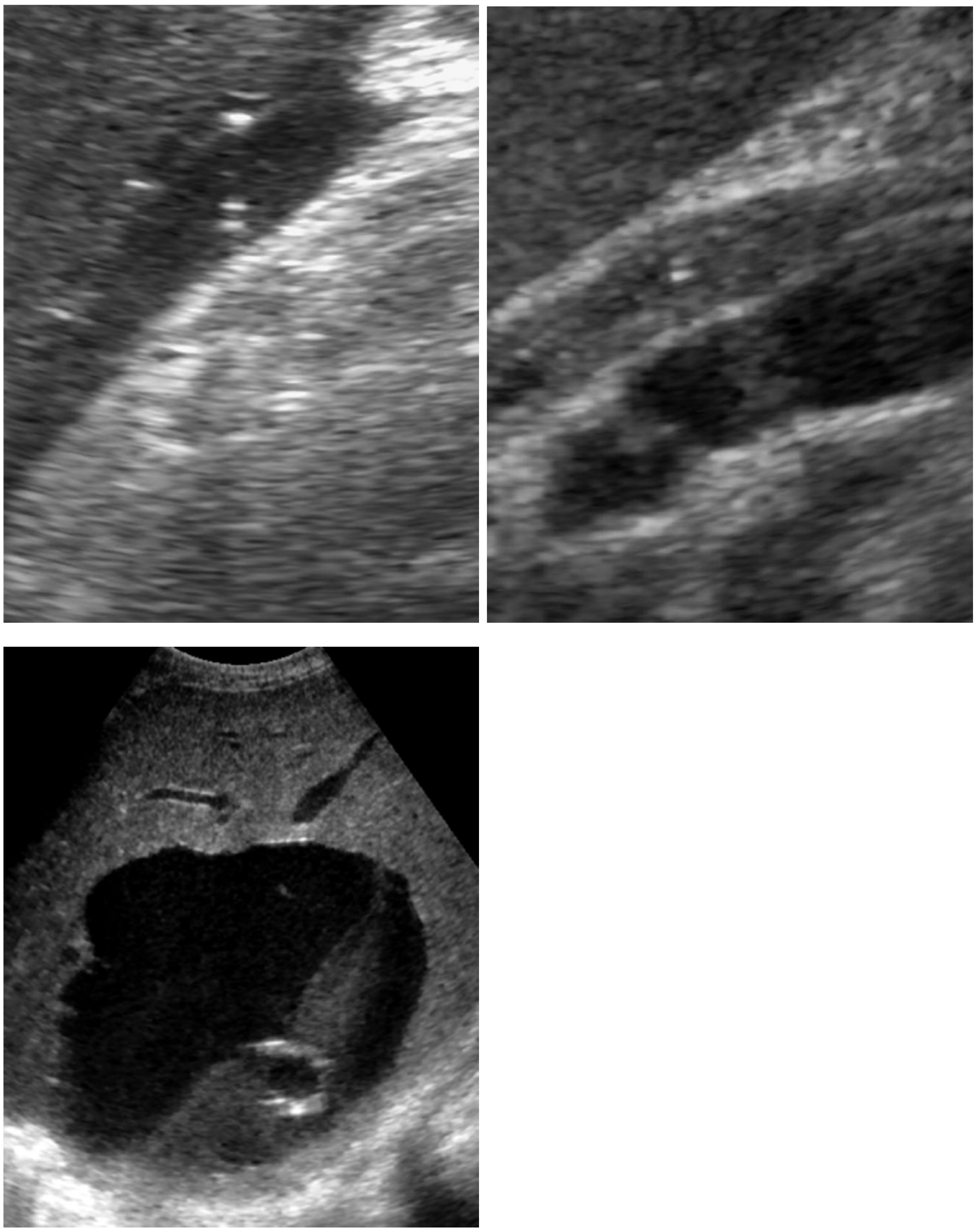


Fig. 4.13.11 a-c Fine needle puncture of subhepatic abscess after cholecystectomy (a, after one-time evacuation b), and catheter tip in a drained liver abscess (c) (different cases); FS right

Fig. 4.13.12 Gallbladder FNP with needle tip (light reflex) and haemorrhage (rapidly forming reflexive extravascular coagulation with complicating haemorrhage at bladder base); puncture in critical free area of gallbladder (minimum distance to lower liver rim 2 cm); FS right

Sonography guided puncture is in individual cases - e.g. for therapeutic puncture of suitable (symptomatic!) pseudocysts or liver abscesses - extraordinarily helpful and can replace surgical intervention; it is if necessary integral part of the examination. The risk is often overrated - especially in English scientific journals.

Suitable puncture instruments are to be tested - and to be kept. The tried and tested should not be abandoned without reason. For example, we conduct one-time punctures for diagnostic or therapeutic purposes always with the stiff and extremely inexpensive disposable lumbar puncture needles with 0.9 mm (yellow) (wall thickness is about 0.15 mm).

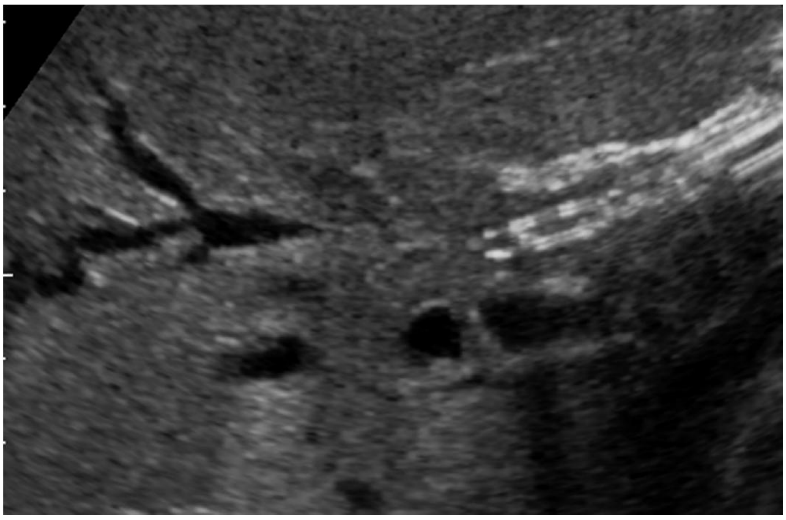


Fig. 4.13.13 Diagnostic sonography guided puncture with visible tip of 0.9 mm needle, stent after EPT in stenosis, rare case of autoimmune cholangitis (sustainable improvement and stent removal as well as complete normalization with 50 mg steroids for 8 weeks); SCS right

Fig. 4.13.14 a, b Quantitative therapeutically drained omental bursa effusion originating from a large retro-gastric pancreatic pseudocyst; UAS transverse with drainage twice; lipase and amylase containing exudate (check!); SCS right (b)

Needle tip movement facilitates its detection during forward movement of needle. Also longer (special) fine needles are used if necessary.

During one-time puncture as much as seems necessary is tapped. For a planned drainage it is recommended to aspirate the few diagnostically needed millilitres, to not unnecessarily reduce the puncture area, and thus risk unnecessarily the non-fine needle share of the intervention.

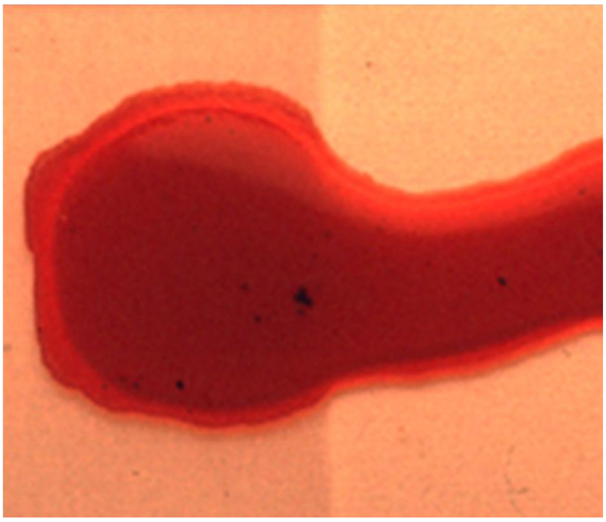


Fig. 4.13.15 Macroscopic evidence (black particles) from malignant melanoma metastasis puncture material.

The macroscopic and microscopic preparation of puncture material should be given undivided attention, namely with all five senses. For example olfactory tests or generous microbiological cultures should be set up (e.g. blood culture vials). There are numerous literature references of individual case studies.

Fig. 4.13.16 Enteroenteric abscess puncture with proof of needle tip (arrow); LAS longitudinal

Please note:

- **use with clear indication**
- **respect second opinion beforehand**
- **always with assistance**

4.14 Miscellaneous

The indication for extra-abdominal examinations (e.g. thyroid gland or arthrosonography) should be liberal, such as in suspected abscess or space occupations of unclear genesis.

Fig. 4.14.01 Examination of left cervical soft tissue and left thyroid lobe

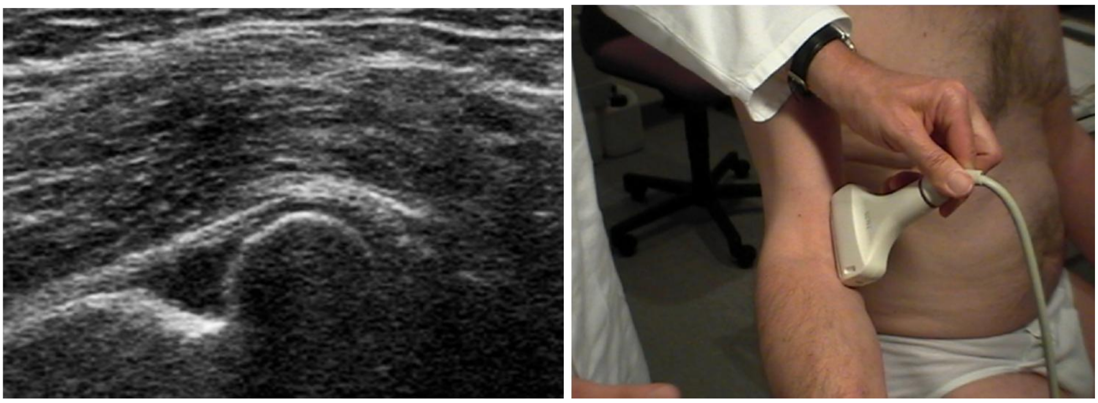


Fig. 4.14.02 a-c Unusual transducer positions: perineal and arthrosonography (b, c)

Fig. 4.14.03 Subcutaneous hyperhydration with "puddles"; upper arm sections

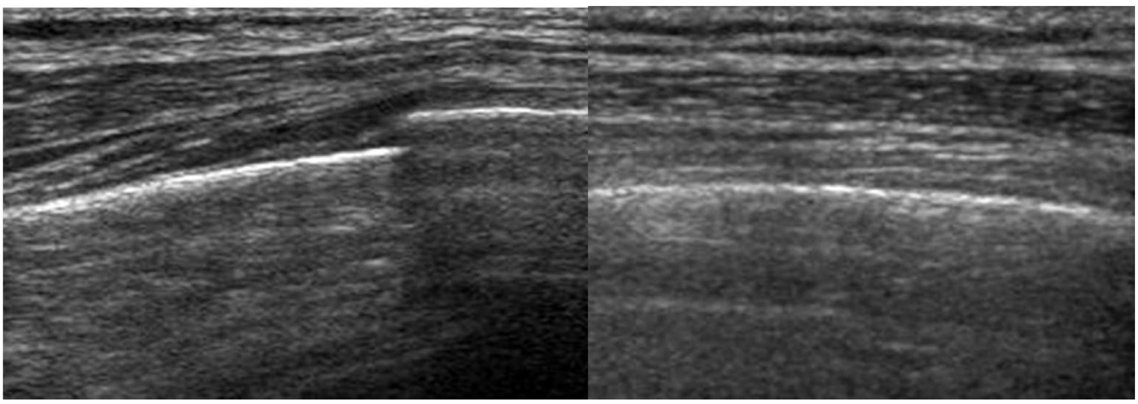


Fig. 4.14.04 a, b Juvenile rib fracture (right image half, left normal finding for comparison); thoracal transverse sections

Fig. 4.14.05 Advertisement for an undertaker seen before a sonography class in Resita/Romania

5. Afterwards - After Lifting Transducer

For the discussion of the findings and the often immediate diagnostic and/or therapeutic consequences resulting from the ultrasound examination - a routine part of our examination adapted to the patient - it is not deemed to make sense, for example, to keep clearly newly found gallbladder stones a secret from the patient. At the next examination (with ultrasound a repetition is possible without problems) they are "discovered" and probably named, which then reflects poorly on the professionalism and comprehensiveness of the preliminary examination.

The examiner has to always question, if he/she has taken clinical circumstances sufficiently into account, and has paid attention to other educational possibilities (congresses, literature), and second opinions of experienced sonographers. Also, it has to be observed meticulously how and what was reported to whom. Most of the time reports for outsiders are more detailed than internal communications.

The duration of the overall examination is about 6-8 minutes, whereby this time can be (markedly) exceeded (Doppler coded duplex sonography, interventions, CM!). For all specific questions (repeated examination) it can go (a lot) faster.

The relative sono-acoustic difference should always be paid attention to as a basic principle of the procedure, in case other image comparisons have to be made, specifically: comparison to images from other procedures. After all, sonography is by now accepted to the extent that it claims its own nosological system - or at least could.

The making of a high probability diagnosis is sufficient as a rule.

Please note:

- ***remember and act accordingly***
- ***likelihoods are sufficient, especially high probabilities***

6. Computer Tomography (CT) and Sonography

Contrary to the frequently found opinion and practice, these are not merely competitors in the field of so-called imaging systems, but are to a large extent two different and thus self-contained procedures - admittedly with often similar fields of indication and parallels in applied technology.

CT is characterized by its static pictures (despite the scrolling pseudo-movements), which has - particularly coronary - a limited resolution, and its well presentable panorama pictures, which remain simple enough to be generally understood.

The high radiation risk (malignoma reducing!) of the procedure it is to be taken into account.

In contrast, sonography is a real-time procedure with high and highest resolution in every parenchyma structure. Furthermore, it also has the big advantage that it can be used immediately, individually, repeatedly, and situationally adjusted. Adjusted for example to an initially not suspected pathological situation, as e.g. small amounts of trapped ascites, or an unusual anatomy, which require immediate procedural rethinking - for instance in the sense of an intervention by sonography guided puncture.

The employment of both methods has its spectrum of indications, and the more frequent and dedicated the harmless sonography is used, the less frequent additional insights will be found by CT. Remarkable is also the high and manifold quality of sonography use in areas with limited accessibility to CT or MR.

List of CT advantages (with a twinkle in the eye):

- less own involvement
- less responsibility
- saves time
- saves money
- respectable pictures
- always available pictures (PACS !!)
- panorama pictures
- simple anatomy
- easy reconstruction
- limited resolution
- static images
- examiner independent
- no obligations for immediate intervention
- technically sophisticated
- a lot of personnel
- expensive
- neutral atmosphere
- limited patient contact
- communicative (for colleagues)
- waiting list

List of sonography disadvantages

- hard self-involving work
- high degree of responsibility
- too fast
- spending of own resources
- rotten print pictures
- no PACS
- sophisticated zoom of region of interest
- numerous anatomical deviations must be taken into account
- demanding reconstruction
- magnifying glass resolution
- dynamic
- examiner dependent
- immediate intervention necessary

- limited technical sophistication
- one-man or one-woman show
- inexpensive
- dark room
- abundant communication obstacles
- immediate availability
- limitless repeatability

Tab. 6.01 Advantages of computer tomography and disadvantages of sonography

Please note:

- ***if it really has to be a CT or MRT***
- ***first push the limits of sonography as a harmless real-time method***

7. Sonopsychology

The psychological implications of the ultrasound examination with the examined (patient) and also the examiner are multifaceted and numerous, and only insufficiently described.

After all, the method - even in its principal harmlessness and easy usability and repeatability - is recognized and known sufficiently, beginning with obstetrical practice. It is universally esteemed, often with only a vague idea of its principally high performance and also its limits; and has even found its way into the world of comics, both in its applications in human as well as veterinary medicine.

The relationships on one hand between the device and the examiner, and between the examiner and the device on the other, are by no means unilateral and unambiguous, they go in both directions. Also the examined and the examiner have their expectations, even misgivings, regarding the device itself, its performance and significance, and the procedure itself. The minor inconvenience of the gel (not warmed in our case) is accepted. Everyone is aware that many a person comes out of the mystic semi-darkness of the examination room differently from entering.

The ultrasound device is by no means neutral, especially for the examined. It could implicate an undesirable or even uncomfortable diagnostic consequence, and the often unintelligible moving images are sometimes attributed with a sort of magical authority, although the device obviously behaves in a passive-neutral way and certainly does not have a life of its own. Nevertheless, interactions between the examined, examiner, and also ultrasound device - in a bilateral "triangular relationship"- are quite the rule and can be observed to different degrees.

The examiner - factually in his/her function initially the superior - is expected to take these facts into account by consistent behaviour. Reactions of the kind: "Goodness me, what is this? “, are strictly to be avoided. The examiner should always be aware of his/her part; the examined scrutinizes the examiner closely (especially mimics and similar non-verbal expressions- one must keep up a poker face).

Statements made by the examiner, their diagnostic interpretation, must be as clear as possible for the examined. By all means it is permissible, besides clear statements of yes and no, not to be able to decide conclusively and to be in need of other, further methods. In every case the affected should know, if and how the treatment will continue, a general stipulation that does not only apply to sonography. The application of sonographic developments should be generous and a matter of course – real high-tech innovations with real-time character (interventions, colour coding, elastography, endosonography, contrast agents, etc.) – by which the examined case remains in one hand.

When communicating the next steps, consequences of results should be by all means subject to a second opinion, and taken into account, if they are communicated within the group or externally. In the latter case they possibly should not necessarily be discussed with sonophile colleagues.

The more details the examiner knows about the concerned "case", the better and faster a decision can be made regarding the further course of the patient's fate. Whereby facts initially classified as secondary can become of utmost importance. Correspondingly, insufficient knowledge of all medical and clinical chemistry details is not helpful. This is a fact that for example makes it difficult or even impossible to demonstrate self-examined patients. The thus associated subjectivity of the method has to be taken into account – as an intrinsic moment, not necessarily as a weakness – an extension of the (always subjective) clinical examination with the help of a powerful machine.

The examiner should always, besides exhibiting a "poker face", be consistently friendly and neutral in front of the examined (and possibly relatives!), and should be very sensitive when placing the transducer, especially in intimate areas. Furthermore, one is well advised to always remember that he/she actually is an undesired specialist and so to speak a partner of the examined only of necessity ("patients hate the doctor" phenomenon).

It goes without saying that other activities of the examiner, e.g. phone conversations, should be kept to a minimum, or discussing the findings in front of the patient. Proficient knowledge, e.g. current literature or latest congress insights, is a prerequisite. With somewhat odd modesty, generally the less than splendid image quality seems to be accepted – although real-time procedures and variable sectioning and image information can easily compete with other glossy (section) pictures – e.g. regarding their higher resolution – and would deserve to be included in the daily ritual of discussion (which still is seldom the case, but should prevail in time).

Characteristic is also the under-utilization of clinical ultrasound encountered particularly in English literature dominated countries, all the way to downright sonophobia. Other methods are preferred (also for legal reasons) that are only seen as "imaging" (whereby the claim of clinical ultrasound is understood differently here in Europe, as a continuation of clinical examination by other means).

The examiner crosses boundaries by (legal) touching, the handling of the examined. This minor but fine fact of non-medical ultrasound deserves without doubt separate attention and mention in connection with the sonographic view into the abdomen (and elsewhere).

This description of "sonopsychology" is naturally amateurish and incomplete, as well incomplete – by no means does it claim to be complete or right. After all, the basic idea – one does more than just pictures – is attractive enough to be characterized, at least to some extent.

8. Concluding Remarks

This book serves a somewhat unusual purpose: Ultrasound is a mostly subjective, and by colleagues imparted, also frequently in part independently learned examination. A descriptive real-time method is to be propagated – clinical ultrasound. Additionally, it is attempted to describe a dynamic examination in a way by static means – surely a bold as well as daring attempt.

Nevertheless, this book should be an encouragement to take the results of clinical and supplementary sonographic examinations seriously. It is without any claim to comprehensiveness – justified criticism as well as warranted additions will be gladly considered, whereby a real end could probably not be found, in the sense of a "never ending story".

The acoustic inquisitive view into the body has become general knowledge, which should be used and implemented medically.

Lucas Greiner, Wuppertal

Christian Jakobeit, Remscheid

Andreas Erhardt, Wuppertal

Acknowledgements

Due to the vast amount of pictures we decided to do without individual picture credits. Nevertheless, we would like to thank the following persons for figures and tables:

MD Gabriele Hanenberg and MD Horst Kinkel, Düren/ Germany
Professor Hubert Zirngibl, Wuppertal/ Germany
Professor Mustapha Benazzouz, Ibn Sina Hospital, Rabat/Morocco
Profesor Sattler, Bad Dürkheim
MD Schierbrock, Wuppertal/ Germany MD
Nazir Ibrahim, Damaskus/ Syria, and Sister Bärbel Padberg, Wuppertal / Germany
Professor Wolfram Wermke, Berlin / Germany
Professor Peter Prohm, Wuppertal/ Germany
MD Eugenio Cervesco, Madrid / Spain
Professor Hussein Okasha, Cairo / Egypt
MD Günter Schmidt, Kreuztal / Germany
Professor Jan Janssen, Wuppertal / Germany
MD Stefanie Meyer zu Altenschildesche, Leverkusen / Germany
Mr. B. Braun and Mr. Mathes

List of Abbreviations

CCC	cholangiocellular carcinoma
CCDS	color-coded duplex sonography
CEUS	contrast medium enhanced ultrasonography
CM	contrast medium
CT	computer tomography
EPT	endoscopic papillotomy
ERC	endoscopic retrograde cholangiography
ERCP	endoscopic retrograde cholangiopancreatography
ESWL	extracorporeal shockwave lithotripsy
EUS	endoscopic ultrasound
FL	focal lesions
FNP	fine needle puncture
FS	flank sections
HCC	hepatocellular carcinoma
ICS	intercostal sections
LAS	lower abdominal sections
LS	longitudinal sections
MR	magnetic resonance
MRCP	magnetic resonance transhepatic cholangiography
MS	mid-sections
PACS	picture archiving and communication system
PSC	primary sclerosing cholangitis
PTC	percutaneous transhepatic cholangiography
SCS	subcostal sections
UAS	upper abdominal sections

Selected Literature

Albrecht T, Bolondi L, et al; EFSUMB Study Group. Guidelines for the use of contras agents in ultrasound. January2004. Ultraschall Med 2004; 25(4): 249256

Braun B, Schwerk L (eds.). Ultraschalldiagnostik. Lehrbuch und Atlas, Ecomed 1993

Braun U, Pospschil A, Pusterla N, Winder C. Ultrasonographic findings in cows with cholestasis. Vet. Rec 1995; 137(21): 537-543

Campbell WL, Ferris JV, Holbert BL, Thaete FL, Baron RL. Biliary tract carcinoma complicating primary sclerosing cholangitis: evaluation with CCT, cholangiography, US, and MR imaging. Radiology 1998; 207 (1): 41-50

Claudon M, Dietrich CF Choi BL, et al. Guidelines and good clinical practice recommendations for contrast enhanced ultrasound (CEUS) in the liver-update 2012: a WFUMB-EFSUMB initiative in cooperation with representatives of AFSUMB, AIUM, ASUM, FLAUS and ICUS. Ultraschall Med 2013; 34 (1): 11-29

D`Onofrio M, Zamboni GC, Tognolini A, et al. Mass-forming pancreatitis: value of contras-enhanced ultrasonography. World J Gastroenterol 2006; 12(26): 4181-4184

Gehmacher O. Ultrasound pictures of pneumonia. Eur J Ultrasound 1996; 3:161-167

Gladisch R. Praxis der abdominellen Ultraschalldiagnostik, 2nd ed., Stuttgart Schattauer, 1992

Görg C, Bert T, Kring R, Dempfle A. Transcutaneous contrast enhanced sonography of the chest for evaluation of pleural based pulmonary lesions; experience in 137 patients. Ultrschall Med 2006; 25 (5): 437-377

Görg C, Bert T. Contrast enhanced sonography of focal splenic lesions with a second-generation contrast agent. Ultraschall Med 2005; 26 (6): 470-4777

Görg C, Riera-Knorreschild J. Pictorial review: colour Doppler ultrasound flow patterns in the portal venous system. Br J Radiol 2002; 75:919-929

Greiner L. Diagnostische und therapeutische Punktionssonographie in der Gastroenterologie Thieme, Stuttgart (1983)

Greiner L, Münks C, Heil W, Jakobeit C. Gallstone fragments in feces after biliary extracorporeal shock wave lithotripsy Gastroenterology 98 (1990)1620-1624.

Greiner L, Wenzel H, Jakobeit C. Biliäre Stoßwellenlithotrypsie – ein neues Verfahren. Dtsch Med Wschr 112 (1987)1893-1896

Greiner L. Clinical ultrasound examination. Gut 39 (1996)772-773

Greiner L. Quantification of the non-quantifiable: images, imaging, imagination and the real truth. Ultaschal in Med (2005), 26183-184

Heyder N,Günter E, Giedl J Obenauf A Hhnl EG.Polypoid lesions of the gallbladder. Dtsch Med Wochenschr 1990; 15(7) 243-247

Jakobeit C, et al. Probleme der sonographischen Verlaufskontrolle nach ESWL von Gallenblaesensteinen. Ultrascchall Klein Praxis 1989; (Suppl.1): 20

Jakobeit C, Greiner L. Pre-and post-ESWL imaging of stones and fragments – the role of clinical ultrasound. Gastroenterology 98 (1990)258-259

Janssen A. Pulsatility index is better than ankle-brachial Doppler index for non-invasive detection of critical limb ischemia in diabetes. Vasa 2005 34(4):235-241

Janssen J, Johanns W, Lehnhardt M, Jakobeit C, Greiner L. Transkutane Sonographie und Endoskopie des gastroösophagealen Abschnittes. Ultraschall 17 (1996)33

Lorenz MW, Markus HS Bots M, et al. Prediction of clinical cardiac events with carotid intima-thickness: a systematic review and meta-analysis. Circulation 2007; 115:459-269

Mathis G. Lungen- und Pleurasonographie. 2nd.ed. Berlin: Springer, 996
Mogensen CE. Diabetes mellitus and the kidney. Int 1982; 21 (5): 673-675

Rettenmaier G, Seitz K, Eds. Sonographische Differentialdiagnostik. Stuttgart,Thieme 2000

Reuß J. Sonographic imaging of the pleura: nearly 30 years of experience. Eur J Ultrasound 1996; 3: 125-139

Schmidt G, Greiner L, Nürnberg D. Differential Diagnosis in Ultrasound Imaging, 2nd. Ed., 2014

Scully RE. Histological typing of ovarian tumours, 2nd ed. Berlin: Springer, 2000

Schmidt G, Goerg C. Kursbuch Ultraschall, 5thed.Stuttgart, New York: Thieme 2006

Seitz K, Bernatik T Strobel D, et al. Contrast enhanced ultrasound (CESUS) for the characterization of focal liver lesions in clinical practice (DEGUM Multicentre trial): CEUS v. MRI – a prospective comparison in269 patients. Ultraschall Med 2010; 31(5):292-299

Taniguchi T, Seko S, Azuma K et al. Autoimmune pancreatitis detected as a mass in the tail of the pancreas. Am J Gastroenterol 1995; 90: 1834- 1837

Keyword Index

B

C

check-up 52, 72, 74, 106, 182, 186, 245

circumscribed 26, 103, 126

D

detection 100, 131, 134, 285

E

F

G

gunshot wound 280

H

lymphadenopathy 23, 60, 89, 110, 121, 154, 172, 186, 205, 206, 255, 258, 260, 262, 263

M

micronodular 46, 60, 66

N

projectile 138

Q

R

radiation exposure 198, 266

S

subtle 23, 160

T

transverse colon 154, 177, 245

U

V