

EFSUMB Course Book, 2nd Edition

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Echoscopy – a new concept in mobile ultrasound

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Introduction

Ultrasonography is the imaging modality that is the most patient-friendly and the most miniaturized, facilitating bedside scanning in a wide range of clinical scenarios [(1-23)]. The clinician, who knows the details of history and findings of the patients, has the best prerequisite to perform targeted and cost-effective ultrasound examinations [(24)]. Indeed the use of some ultrasound application by the clinician him/herself has become routine practice in many disciplines and is usually not resorted any more to radiologist. Some of the many examples include echocardiography for cardiologist, transvaginal or fetal ultrasound for obstetric/gynecologists, hepatobiliary ultrasound for hepatologist, peripheral Doppler for vascular surgeons, intraoperative ultrasound for liver surgeon, thyroid ultrasound for endocrinologist, geriatric ultrasound [(17)] or general applications for internal medicine [(18, 23)]. Thanks to the rapid evolution of information technology, it is now possible for the clinician to put simple mobile scanners in the pocket of the white coat and scan the patient rapidly bedside. This great opportunity is paving the way for a paradigm shift in medical patient examination exchanging the stethoscope with the Echoscope [(25)].

Over the last decade the use of mobile scanners has migrated to various medical disciplines. These scanners can be utilized with battery power and often also include all conventional and Doppler ultrasound features, even occasionally offering contrast-enhanced technology. These equipments may be hand-carried, but are often better managed with small wheel cars to be brought to the patients. These mobile scanners are easily utilized in emergency settings [(5, 20, 22, 26-29)], since they can be very quickly switched on and utilized bedside urgently with a small spatial occupancy, leaving space to other persons of the health staff to continue their activities with the patient, differently from high quality large scanners. The advent of such portable scanners opened the way to the concept of point-of-care ultrasound, namely “ultrasonography performed bedside and interpreted directly by the clinician” [(30)]. Direct bedside performance of ultrasonography by the clinician in charge of the patient has the added value of following rapidly new diagnostic hypothesis and support immediate therapeutic decisions [(31, 32)]. Point-of-care ultrasonography is not focused at replacing comprehensive ultrasonography, but at giving the physician immediate access with imaging technology to clinical problems for rapid patient management. However, point-of-care ultrasonography requires adequate knowledge and training in ultrasonography by the

operator combined with clinical skills in the respective clinical situation. As ultrasonography is a relative observer dependent method, the skills and experience of the person scanning is of major importance. Particularly, when performing echoscapy and point-of-care ultrasound it is vital to be aware of the limitations of the actual study, both regarding equipment performance and own level of competence. Accordingly, education and hands-on training in ultrasonography is mandatory to secure sound integration in clinical practice.

The European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) is continuously working to promote high quality education in ultrasound. EFSUMB has defined three levels of practice of ultrasound that ideally must be matched with courses and training:

Level 1:

Practice at this level would usually require the following abilities:

1. to perform common examinations safely and accurately
2. to recognise and differentiate normal anatomy and pathology
3. to diagnose common abnormalities within certain organ systems
4. to recognise when referral for a second opinion is indicated

Within most medical specialities, the training requisite to this level of practice would be gained during conventional post-graduate specialist training programmes.

Level 2

Practice at this level would usually require the following abilities:

1. to accept and manage referrals from Level 1 practitioners
2. to recognise and correctly diagnose almost all pathology within the relevant organ system
3. to perform basic, non-complex ultrasound-guided invasive procedures
4. to teach ultrasound to trainees and to Level 1 practitioners
5. to conduct some research in ultrasound

The training requisite to this level of practice would be gained during a period of sub-speciality training, which may either be within or after the completion of a specialist training programme.

Level 3

This is an advanced level of practice, which involves the following abilities:

1. to accept tertiary referrals from Level 1 and 2 practitioners

2. to perform specialised ultrasound examinations
3. to perform advanced ultrasound-guided invasive procedures
4. to conduct substantial research in ultrasound
5. to teach ultrasound at all levels
6. to be aware of and to pursue developments in ultrasound

The level of ambitions for medical students should be to acquire knowledge and skills during their curriculum to be well under way into level 1. Fortunately, there are educational programs in bedside ultrasound evolving for medical students and fellows [(33-35)]. EFSUMB also envisions three levels of practice regarding mobile ultrasonography (in which any of the superior includes the previous inferior level):

1. Echoscapy, often using hand-held devices
2. Point of care ultrasound, often using low-end scanners
3. Comprehensive advanced ultrasound with high-end scanners, moved on wheels to the bedside.

For clinical examples of item 1) and 2), see Figures 1-28.

Despite small screens and limited resolution of hand-held ultrasound scanners, the advantages of such miniaturized devices are clear and straightforward. They can easily be used rapidly bedside to extend the physical examination, and in many cases replace the stethoscope. Moreover, studies have shown that the image quality of small scanners often is surprisingly good [(24, 36)]. It is important to realize that some clinical issues can easily be clarified and do require neither comprehensive knowledge of ultrasonography by the operator nor high-performing scanners. To clearly distinguish these two situations, two different names for the two settings are applied. In the first instance, termed Echoscapy, only one answer (or very few), usually in the terms of yes or no, is required to solve a specific clinical question [Table 1].

Table 1 A list of the most common clinical scenarios which can be solved bedside using a basic level of ultrasound knowledge and with pocket size scanners. The examination is defined as Echoscapy according to the EFSUMB point of view. Cardiologist also suggest that echoscapy is suitable to answer the question whether the cardiac global ejection fraction is severely compromised or not,

which might be particularly useful at the first assessment of some patients [(36)].

Clinical Situation	Clinical Question	Echoscopic answer
Abdominal enlargement. Obesity or ascites?	Free abdominal fluid?	YES or NO
Area of Pulmonary dullness at percussion*	Presence of pleural effusion?	YES or NO
Tachycardia, weak tones, low voltages on EKG	Pericardial effusion?	YES or NO
Pulsating mass in epigastrium at palpation	Aortic aneurysm?	YES or NO
Marked decrease / lack of urinary bladder output	Bladder overdistension?	YES or NO
Worsening of renal function	Hydronephrosis?	YES or NO
Jaundice	Dilated intrahepatic biliary tree?	YES or NO
Suspected mass at abdominal palpation	Mass confirmed?	YES or NO
Enlarged spleen ?	spleen length, longer than normal	YES or NO
Reduced urinary output in patients with catheter	Catheter correctly placed ?	YES or NO
Suspected cholecystitis	Large gallbladder stones?	YES or NO
Fluid aspiration required	Fluid confirmation and location prior to aspiration / drainage	Choice of puncture site

The answer can be reported in the clinical journal of the patients as an extension of the physical examination and does not require a full ultrasound report, provided that it is specified that the exam was an Echoscopia performed bedside. To perform this task, pocket-sized ultrasound scanners are well suited. In the second situation (relating most often to level 2 and 3), usually termed echography or ultrasonography, either performed bedside or in the ultrasound lab, an assessment of the region related to the suspected disease is performed to search for pathology, usually assessing more than one organ (e.g. various abdominal organs, or assessment of the thorax, or the neck, etc). A full report of the examination is always required and images of the examined organs, at least pathological findings, are usually collected.

The “echoscopia” approach with pocket size devices has been already addressed also in the cardiology field, specifically in a document of the European Association of Echocardiography (36). Pocket-size devices should complement the physical examination in outreach clinics, in coronary and intensive care units, and may serve as a tool for fast initial cardiac assessment in emergency units, during cardiologic counselling in- or outside health-care facilities and hospitals, for first cardiac evaluation in ambulances and for screening programmes in

schools, industries, and other community activities. They do not provide a complete diagnostic echocardiographic examination and the assessment should be reported as part of the physical examination of the patient.

The advantage of Echoscapy in general is that it will be easily accessible to most clinicians, manufactured to solve clinical problems during their rotations in any hospital ward or even outside the hospital. The clinical ultrasound approach to these cases can be learned in a fairly short time and pocket sized scanners can be made available, even during nighttime duties. Such scanners do not require to be locked inside the ultrasound lab, but can be kept in the clinical wards or in the pockets of the doctors. For the operator it is important to clarify whether the specific examination is defined as full Echography or limited Echoscapy, according to his/her skills and to the performance level of the ultrasound scanner used. Under any circumstances, Echoscapy has a great potential for efficient, tailored diagnostics and treatment and hand-held ultrasound scanners appear to be of major importance in the doctor's toolbox.

Figures

Figure 1 Normal Gallbladder and liver using Vscan™.



Figure 2 Normal right kidney using Vscan™

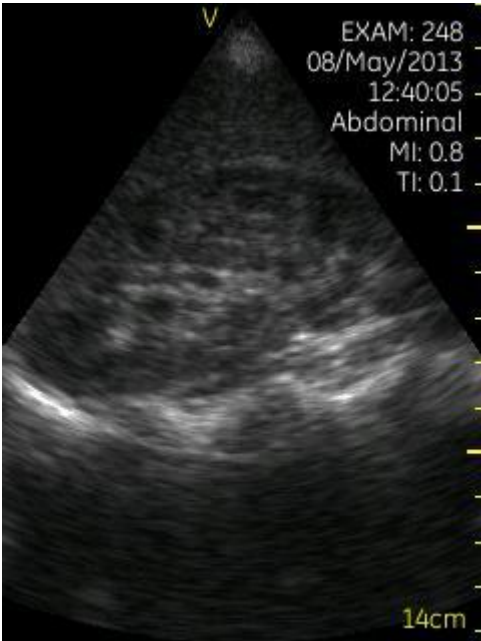


Figure 3 Epigastric scan of the normal pancreatic head using Vscan™.



Figure 4 Normal liver and portal vein using Vscan™.



Figure 5 Color Doppler of the portal vein using Vscan™.

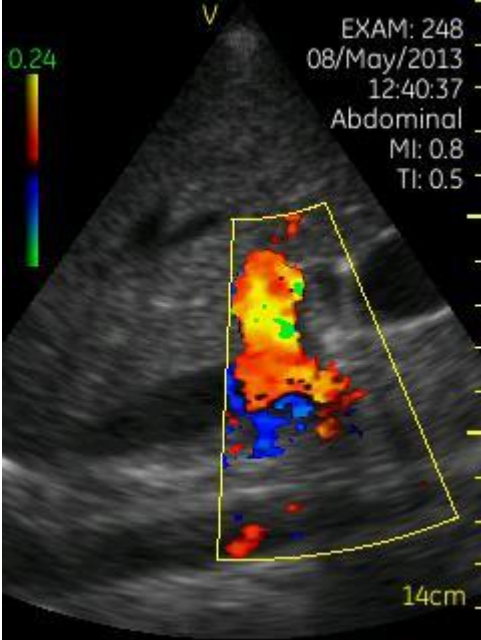


Figure 6 The tail of the pancreas scanned through the spleen as acoustic window using Vscan™.



Figure 7 The antroduodenal segment using Vscan™. Dorsally one can observe the aorta and the cava vein.



Figure 8 Perihepatic ascites in a patient with liver cirrhosis using Vscan™.



Figure 9 Dilated hepatic vein seen in severe heart failure using Vscan™.



Figure 60 Gallbladder wall thickening using Vscan™.

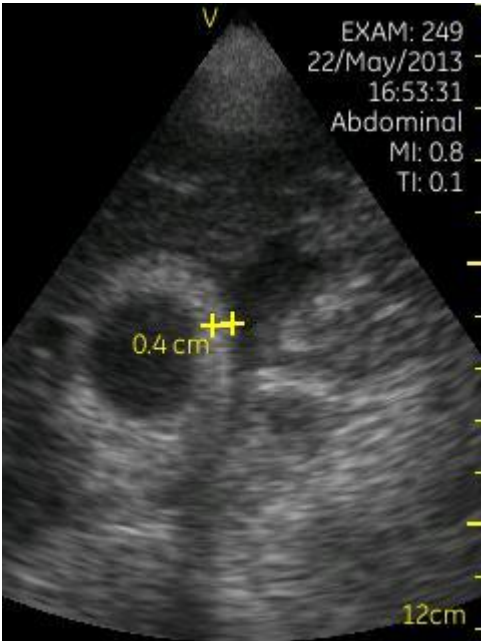


Figure 71 Splenomegaly visualised using Vscan™.

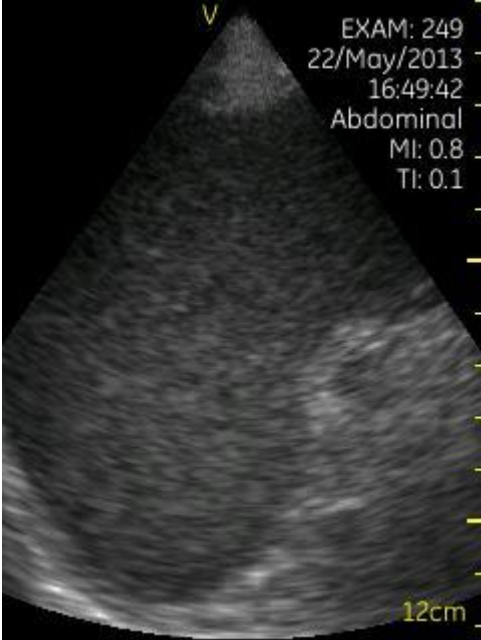


Figure 82 Abdominal aorta aneurysm with parietal thrombosis using Vscan™.

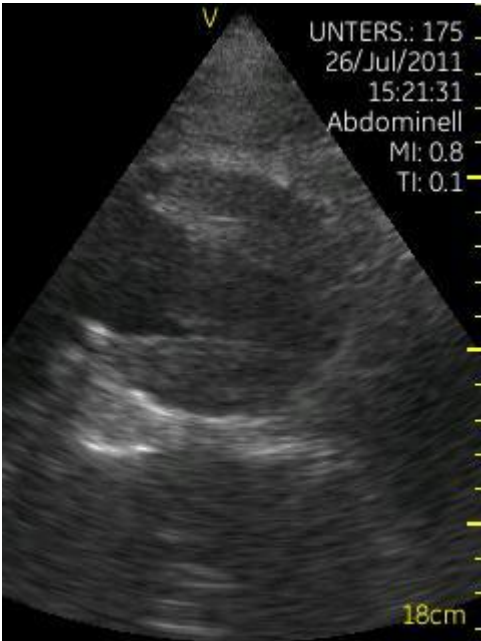


Figure 93 Abdominal aorta aneurysm in a longitudinal section using Vscan™.



Figure 104 Hypoechoic liver tumour using Vscan™, deeply located within the liver parenchyma (fatty liver).



Figure 115 Echorich tumour of the renal pelvis using Vscan™, typical finding of angiomyolipoma.



Figure 126 Hydronephrosis using Vscan™.

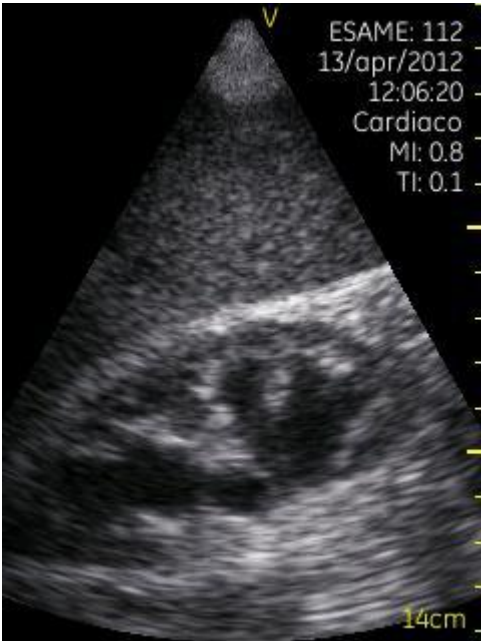


Figure 137 Urinary bladder with inferior sediment using Vscan™.

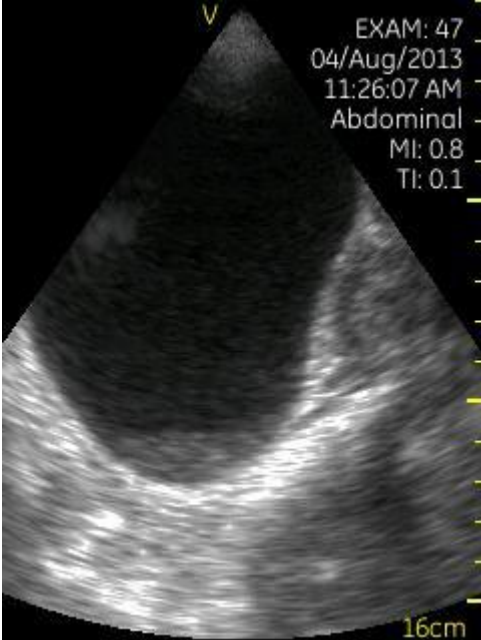


Figure 148 Acute cholecystitis using Vscan™.

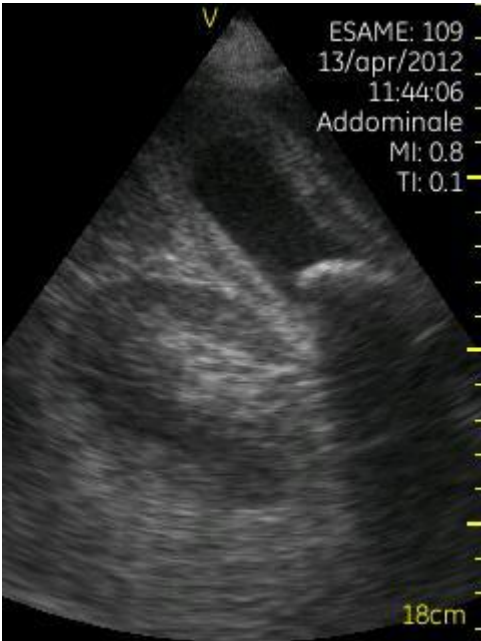


Figure 159 Tortuous aorta viewed through the spleen using Vscan™.

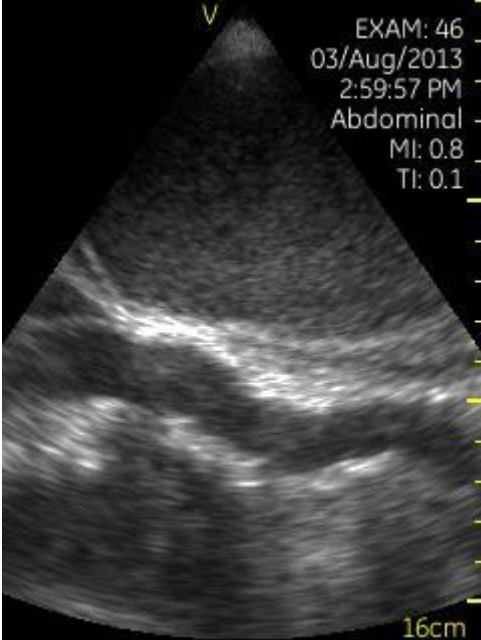
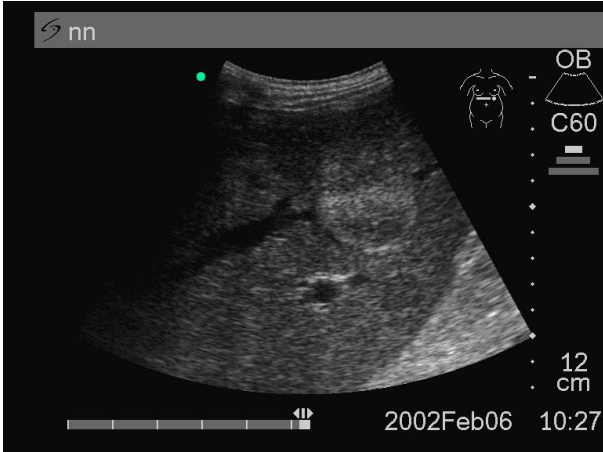


Figure 20 Pulmonary atelectasis using Vscan™.



Figure 21 Hyperechoic liver tumor using Sonosite 180™.

a



b



C



Figure 22 Hypoechoic liver metastasis using Sonosite 180™.

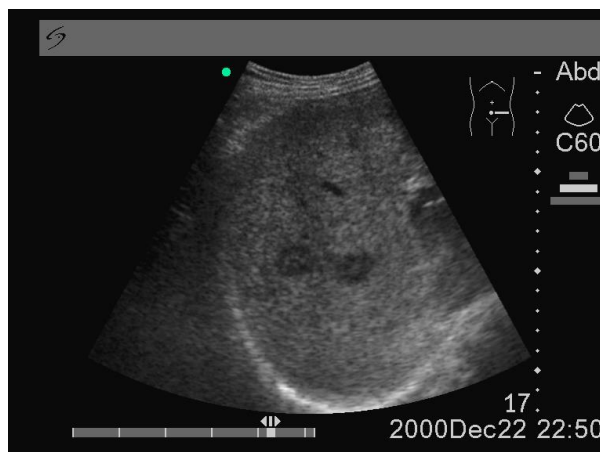
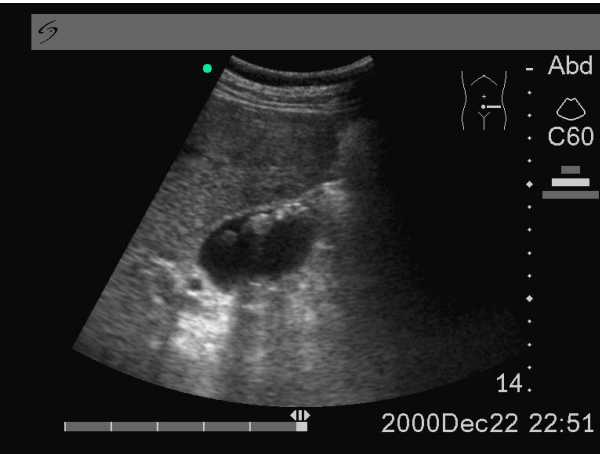


Figure 23 Gallbladderstones in otherwise normal gallbladder using Sonosite 180™.

a



b

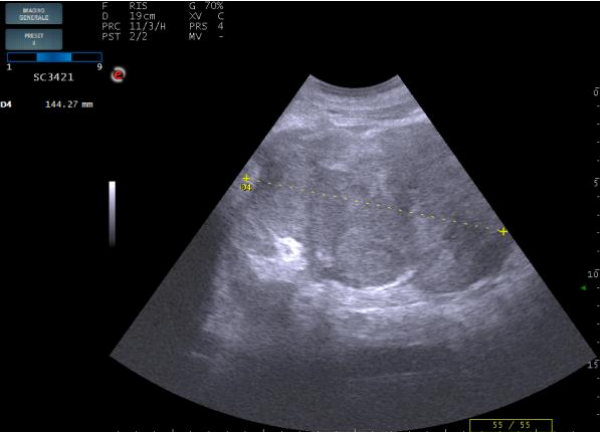


Figure 24 Left pleural effusion caused by a metastatic implant (a small tumoral mass is well depicted on the diaphragmatic surface of the pleura) (Sat scanner, Esaote™).



Figure 25 In a patient in whom the chest X-rays shows abundant pleural fluid, bedside ultrasound prior to thoracocentesis additionally demonstrates a marked thickening of the thoracic wall, suggestive of neoplastic invasion. The aspect of the thoracic wall is important before thoracocentesis since a too short needle may be insufficient to reach the fluid (Sat scanner, Esaote™).



Figure 26 Large renal cancer without hydronephrosis in a patient referred for possible renal stones, on the basis of very recent onset of left flank pain and microhematuria (Sat scanner, Esaote™).

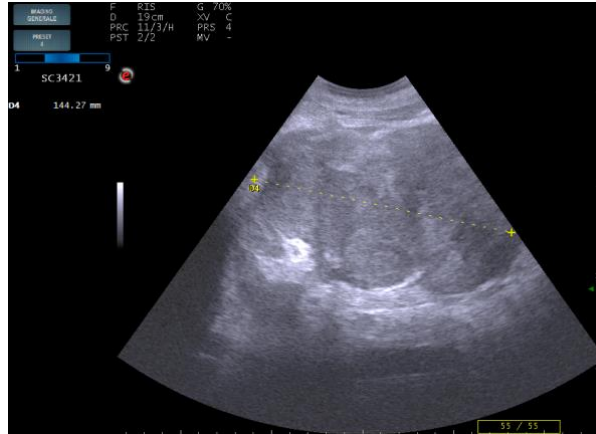


Figure 27 Modest amount of free abdominal fluid surrounding bowel loops (Sat scanner, Esaote™).



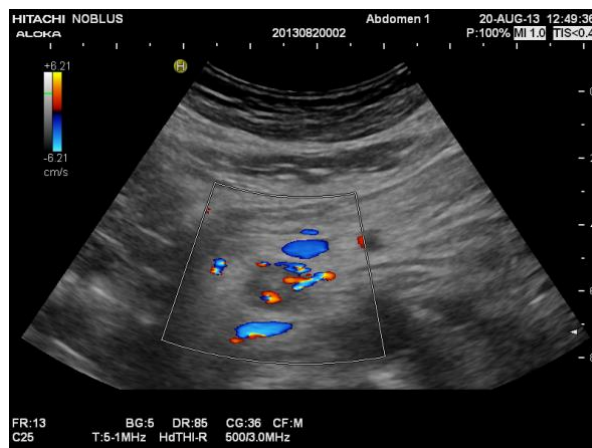
Figure 28 High-end handheld device [Hitachi Noblus] used to characterize metachronic and multiple hypervascular metastases of renal cell carcinoma (15 mm). The different transcuteaneous options are shown by using B-mode (a), colour Doppler imaging (b) and contrast enhanced ultrasound (c) both proving a hypervascular lesion. Endoscopic ultrasound displays the hypervascular lesions

in more detail in the different techniques. Colour Doppler imaging (d) and contrast enhanced ultrasound (e) are revealing the typical hypervascularity. Real-time elastography shows typically softer (4) lesions compared to typically stiffer ductal adenocarcinoma (f).

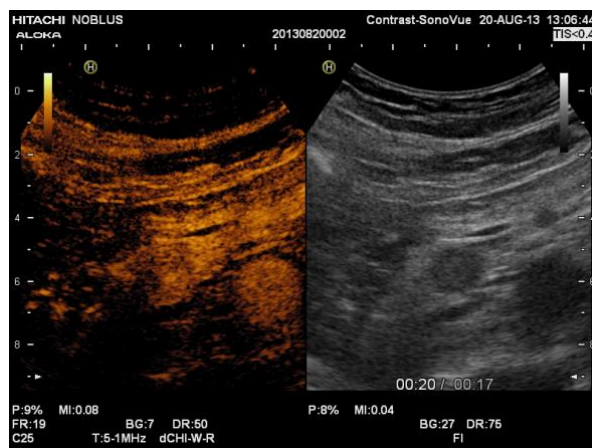
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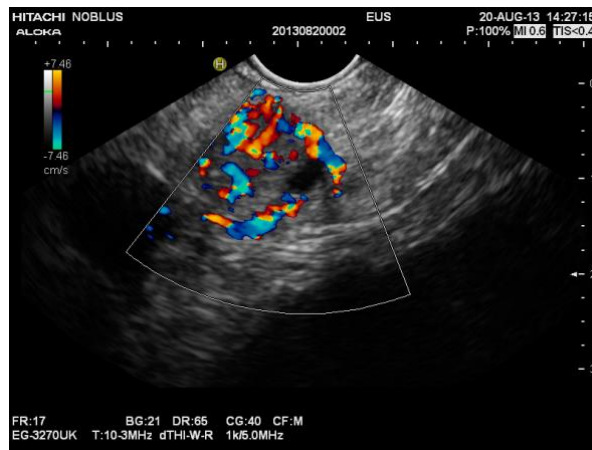
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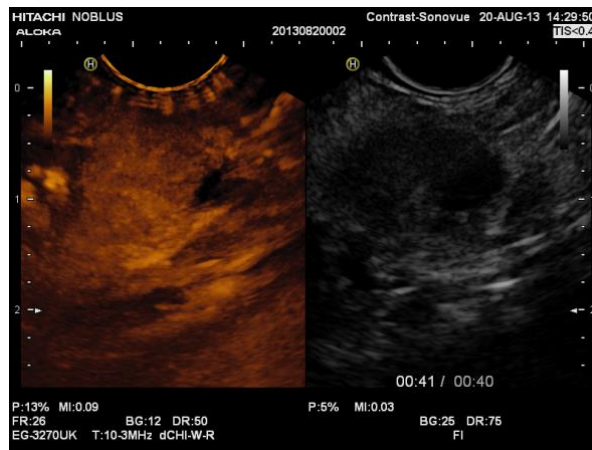
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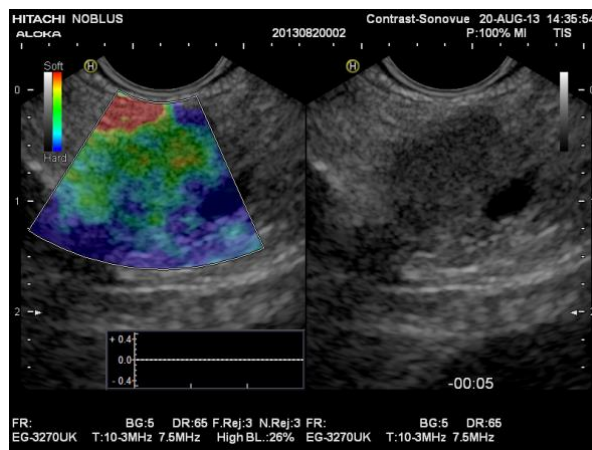
d



e



f



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