

Clinical Abdominal Ultrasonography (US) – Benefits, Potentials, and Limitations

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It might be unbelievable for younger colleagues, but it is true: it is only 30 years ago that the only person to see inside the abdomen was a surgeon. So it was his responsibility to diagnose a patient with abdominal problems.

Things have changed considerably – due to the combined use of first sectional imaging (especially abdominal ultrasonography), and secondly due to gastrointestinal endoscopy. So today the surgeon – if required – is provided with an optimum of pre-operative information.

In many European countries, not only endoscopy, but also ultrasonography is performed by the gastroenterologist himself. This is the most appropriate way of having immediate, precise, and highly informative insight into the abdomen by the physician responsible.

So what does clinical ultrasonography mean – as the first or the other eye in modern gastroenterology - today?

After the patient's history is taken, ultrasonography is an integrated part of the physical examination of the patient – rendering real time sectional images from all abdominal organs; the multiple slices of these images give – as a whole – an actual three dimensional status of the individual anatomy and pathology.

Simply, you can look into the abdomen and read it like an open book.

And basically, this is not difficult, especially with up to date ultrasound machines of the middle or high end class.

This equipment renders detailed realtime pictures from all parenchymatous organs - liver, pancreas, kidneys, spleen/lymphnodes, prostate -, and from all fluid containing organs and tubular structures - gallbladder, urinary bladder, abdominal and parenchymal vessels of all types, and including the gut irrespective to their fluid content – blood,

bile, pancreatic juice, urine, and intestinal fluid contents.

Especially the combination of ultrasound imaging and subsequent endoscopy by one and the same gastroenterologist has turned out to be highly beneficial for the patient, the clinician in charge, and national health budgets. High quality endoscopy is well established and performed in many GI-centres. The other eye that looks into the abdomen – clinical ultrasonography – has found its true name in the Italian language: *ecoscopia*, to look into something with the help of acoustic echoes.

Ultrasonography has already now become the stethoscope of the third millennium. Looking into the abdomen is not only possible by endoscopy, but in many respects, even better, by means of ultrasonography. Multiplane sectional imaging in real time fashion with a resolution capacity not achievable by any other imaging modality, combined with a maximum of ease in application and in learning – all this makes clinical ultrasonography the primary choice in addition to physical examination. This applies to routine cases of any abdominal disorders and in gastrointestinal emergencies of all kinds. All data of the patient's history can be integrated at once. Moreover, clinical real time ultrasonography is safe (no irradiation hazard) and uniquely cost effective, repeatable even as a bedside method, and without any waiting list. The enormous amount of immediate information rendered by clinical ultrasonography in a given patient has become an indispensable tool for the active internist and gastroenterologist worldwide.

In the routine management of patients, the ultrasound insight into the abdomen easily depicts normal and pathological anatomy, including real time information concerning the normal or hindered flow of liquids, and indicating the source and the reason of localized pain, masses, or impaired organ functions. One can simply see the outer margins and dimensions of the parenchymatous organs (liver, pancreas, kidneys, spleen, and lymphnodes)

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as well as their internal structure ("echopattern") with respect to normal appearance or either diffuse or localized (focal) pathology. In addition, all fluid containing structures in the abdomen are simply visualized by ultrasound: bile juice or urine containing bladders and vessels such as intra- and extrahepatic bile ducts, the gallbladder, or the ureter; blood containing vessels of all types; and the main pancreatic duct containing pancreatic juice. This is true as well for all pathological fluid collections such as ascites, pleural effusions, empyema, or abscess formations. Even the intestinal structures of the terminal esophagus, stomach, small and large intestine are good targets for ultrasound examination and evaluation of their peristalsis, contents, and wall structures.

In *biliary disease*, as an example, US is the first diagnostic tool to prove or to outrule biliary calculi (especially in the gallbladder with a close to 100% sensitivity and specificity), to prove or to rule out acute or chronic cholecystitis or tumors, to prove or to rule out biliary obstruction (including the level and the reason of obstruction with or without jaundice). Moreover, US allows an immediate and accurate decision regarding the further diagnosis and therapeutic course in a given patient, and how to follow up a patient after antibiotics, or endoscopically or US-guided interventions. US is indispensable in any form of biliary disease, and it should be performed by the responsible clinical physician to better evaluate the diagnostic and therapeutic targets.

The beneficial role of clinical ultrasonography becomes especially obvious in the management of emergency patients in gastroenterology. Most inflammatory acute abdominal disease will be detectable by clinical ultrasonography due to swelling and local pain e.g. acute cholecystitis, pancreatitis, obstructive cholangitis, or diverticulitis. Some exceptions must be made as acute hepatitis will render indirect signs of inflammation only (such as sludge formation in the gallbladder).

Perfusional malfunctions and malconditions such as venoocclusive diseases of the liver or acute diseases of the abdominal aorta (perforated aneurysm, occlusion of the intestinal arterial branches) are rapidly found or excluded with clinical ultrasonography including colour and doppler modalities or spontaneous contrast enhancing by gas bubbles in the portal blood due to gasforming bacterial infection of necrotizing intestinal loops.

Inflammatory benign or malignant tumors of the intestine or of the hepatobiliary tract, or from other abdominal origin leading to acute complaints are easily detected by clinical ultrasonography.

Pathological fluid and/or gas collections in the free abdominal cavity due to intestinal perforation, bleeding,

abscess or ascites formation are at once accessible to diagnostic clinical ultrasonography.

Ultrasound guided palpation and intervention – e.g., diagnostic fine needle aspiration biopsy confirming pus, or therapeutic ultrasound guided drainage of an abscess or a gallbladder empyema – are helpful features of clinical ultrasonography as well.

Every medical doctor should know the beneficial role of ultrasonography in abdominal disease and elsewhere, and he should not only know it but include it actively in the diagnostic and therapeutic management of patients.

Among the new technologies such as tissue harmonic imaging (THI), phase inversed US, three dimensional US, etc., the use of intravenous contrast enhancing substances is about to be established.. Contrast enhanced ultrasound (CEUS) is increasingly better defined in its indications and ways of application, adding a new dimension of functional information especially in the US evaluation of focal liver lesions. Other new technologies will have an even closer approach to the histopathological classifications of parenchymatous tissues, achieving a better quantification of e.g. changes of liver parenchyma in differentiating the normal tissue from a fatty or a cirrhotic liver ("parametric ultrasonography", "elastography"). These quantifications are promising, however, they still require further evaluation and development. Another breakthrough will be real time and easily applicable three dimensional reconstructions produced by US scanning.

The *limitations* of US in abdominal disease are usually attributed to interfering intestinal gas load, to examiner dependency, to the obesity of the patient, or to combinations of these three "obstacles". In reality, however, all these three can be overcome quickly – gas formations by local gentle pressure, examiner dependency by training (as in any man-operated area), and obesity by good US machines.

The true limitations of US are somewhere else. Maybe, in the brains of potential users e.g. hepatologists, who only now slowly are accepting the potential of clinical ultrasonography in evaluating the liver directly in health and in disease; or in the Anglo- Saxon-driven literature world, which until now has not yet found the hidden jewel of clinical US. Or there might be limitations due to turf battles between radiologists – pretending to be the only medical species to be able to evaluate images and imaging with competence – and other potential users of clinical US, such as gastroenterologists.

Apart from these more or less professional or psychological obstacles and limitations, US indeed is being hampered by too little training and understanding (and like many other techniques), and by a limited access to specific

areas (e.g., left upper abdomen, gas filled structures like lungs, , etc.). The potential of clinical US, however, by far exceed its limitations.

In conclusion, do not say learning and performing ultrasonography is too difficult for a clinician. This is not true, every medical doctor (even surgeons) can learn ultrasonography. Do not say it is too time consuming – this can be reimbursed rapidly (and this is true from the economic viewpoint, too). Do not say, CT scanning or MRI

are better – this is as a rule this is not the case with most patients. Do not say these other imaging modalities are less user dependent – this is false too. Clinical ultrasonography is indispensable for a quick decision for the next diagnostic and therapeutic steps required in a given patient. Both the patient and the doctor will benefit markedly from the ease, safety, repeatability and diagnostic value of the ultrasound methodology to visualise the abdomen with a clinician's responsibility and integrative understanding.