

Remote echography using motorized probe and tele operated echograph

Echography and Doppler are the first imaging modality which can be setup without huge and costly installation, but the examination has to be performed by a Medical Doctor specially trained for echography and Doppler (a Sonographer). Moreover this sonographer must be specialized in echography/Doppler in various domain like abdominal, pelvic, vascular, fetal investigation. Thus it is evident that such multi-disciplinary sonographer cannot exist in isolated medical center with limited facilities and served by only general practitioner (GP) assisted by nurses and midwife. Remote echography and Doppler could be of great help for the GP to quickly identify emergency situation with patient to be transferred immediately and other cases that can be treated on place. A new compact system with a tele-operable light echograph (setting and function controlled from away) equipped with motorized probes (transducer orientation controlled from away) was built up (Sonoscanner Paris) and tested for tele echography/ Doppler.

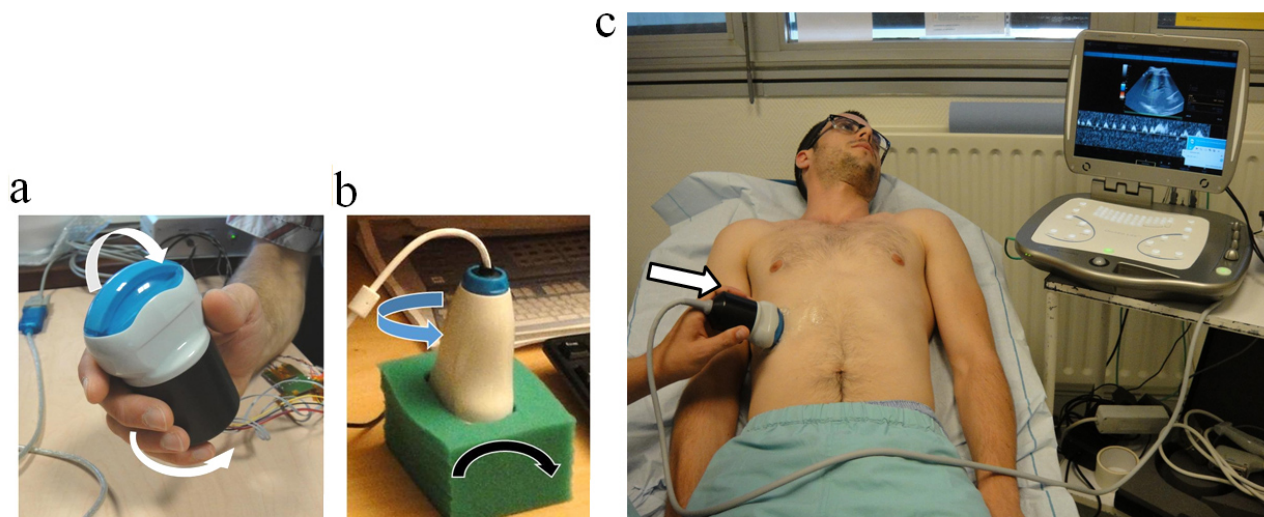


Fig. 1. (a) Motorized probe (400 cm^3 , 430 g). The transducer (3,5MHz) is remotely tilted and rotated (arrows) from away by the expert manipulating (b) the dummy probe. (c) patient site with tele-operated probe and echograph.

Portable Echographe and probes Tele-operated: A commercial echograph (Orcheolite, Sonoscanner, Paris, France) was modified to allow for tele-operation through Internet (soft Teamviewer, Germany). At the Expert site, the trained sonographer adjusted the settings (gain, depth, etc.) and functions (Doppler, colour, 3D, etc.) of the echograph using a PC keyboard. The design and weight (6kg) of the echograph was not altered; but, new functions were added including elastography, 3D reconstruction, Panoramic, radio frequency (RF) display... A Motorized probe

(400g; 430cc) for deep organs (abdomen and fetus) was developed with a convex array transducer (3.5-7MHz), one motor to tilt the transducer (+55° to -55°) and a second one to rotate the transducer around the central axis (+/-180°) (Vermon, Tours, France). The probe for the superficial targets contained a linear array transducer (5-15MHz) tele-operated using one motor for the tilt movement (+55° to -55°). The movements of the Expert dummy probe were mimicked by the transducer of the motorized probe at the patient site (Optimalog, St. Cyr-sur-Loire, France). At the Expert site, a basic PC, connected to Internet, was used to tele-operate the echograph and motorized probe and for the videoconference (IP AXIS camera, Paris) between the two sites.

Tele-echography procedure: The patient site Doctor call the Expert and present the clinical status of the patient and schedule the examination.

At the beginning of the tele echography the *Expert tells* the distant operator to locate the motorized probe on the acoustic windows of the organ to be investigated. then the Expert ask the operator to maintain the probe motionless, while he tilt and rotate the transducer until he get the expected view (Gall bladder, Kidney, Pancreas, Aorta, fetus...). The Expert adjust the gain, depth... on the echographic image and freeze and store the image. In the case of vessel investigation the Expert activate the Color Doppler and locate the Doppler sample volume inside the vessel lumen and finally triggers the pulsed Doppler mode and adjust the Doppler spectrum brightness, baseline, scale...

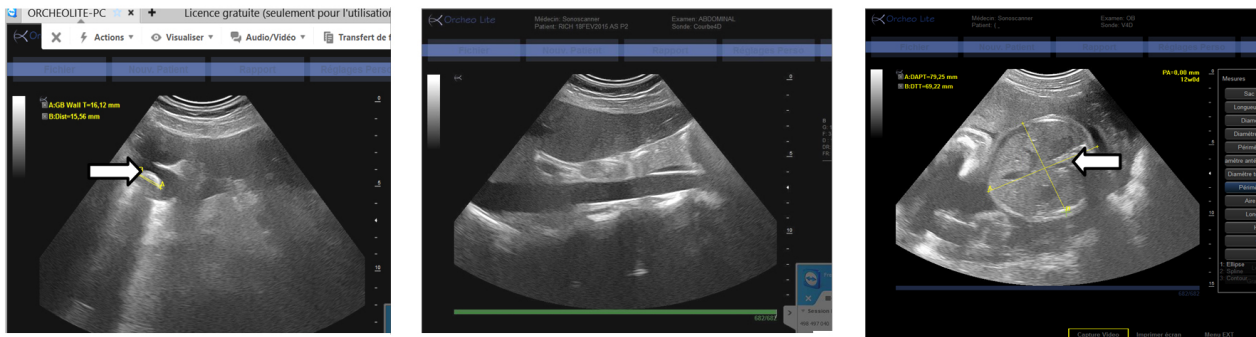


Fig. 2. a) Lithiasis in Gall bladder b) Liver, inferior vena cava c) Fetal abdomen.

Tele echography in rural area: 200 patient located in: Health house, Senior living communities (rural area in France), a medical center south limit of Europ (Ceuta) and a dispensary in the Amazonian forest (French Guyana) were successfully investigated. The operator by the side of the patient was not trained at all for echography. The link between the Expert and patient site was a ground or a satellite Internet (512Kb/s to 1Mb/s). The time duration of the tele- echography was 15 to 20 min, the diagnosis was delivered in 97% of the case. The device has been tested onboard the space station in 2017.

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Publication

[Teleoperated Echograph and Probe Transducer for Remote Ultrasound Investigation on Isolated Patients \(Study of 100 Cases\).](#)

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