

By Dr A Colli & Dr D Prati

The impact of Pocket Ultrasound Devices on physical examinations

The recent development of miniaturized ultrasound systems has resulted in the improvement of the diagnostic accuracy of physical examinations and increased the appropriateness of further testing. This article summarizes the advantages of Pocket Ultrasound Devices (PUDs) and describes the results of a study designed to evaluate the effect of their use in the examination of patients with suspected common abdominal conditions.

Over the last 20 years, the increasing availability of fully functional, compact ultrasound equipment has allowed ultrasonography (US) to be carried out at Point-of-Care sites, such as at the patient bedside [1]. Modern miniaturized ultrasound systems are now the size of a smartphone, so can fit in a clinician's pocket and provide real-time dynamic images, thus enabling physicians to visually inspect a patient's internal anatomy while carrying out a physical examination. Direct correlations of the US findings can be made with the patient's clinical history and symptoms. Classically, physical examinations are based on inspection, palpation, percussion and auscultation. For a long time the stethoscope was the only device which could improve the performance of such exams.

However the accuracy of classic semiotics is poor, with low reproducibility, sensitivity and specificity [2]. PUDs are increasingly being seen as a tool with the potential to improve the performance of bedside diagnoses.

For example, in the field of cardiology, the results obtained by PUDs have been

considered to be comparable to those obtained with standard equipment and therefore suitable for widespread use [3, 4]. Students carrying out examinations using PUDs have been shown to be more accurate in making certain diagnoses of heart diseases than expert cardiologists using physical examination alone [5]. More recently, the accuracy and reproducibility of a PUD examination have been confirmed in the detection of ascites and focal liver lesions, which are the leading indications for abdominal US.

Thanks to constant technological improvement there is substantial equivalence of images with those from conventional ultrasound devices, so it is not surprising that the values of PUD accuracy are similar to those of conventional systems.

However the downstream effects of the use of PUD-assisted examination on clinical endpoints still need to be described.

A recent pragmatic randomized clinical trial carried out in patients with suspected nephrolithiasis, found that a differential diagnostic tree based on the use of PUD showed no differences with those established by radiology US and CT in terms of 30 days incidence disease complications [6].

Other questions still to be answered are how — and for how long — a clinician with no previous experience in ultrasound needs to be trained in order to reach an acceptable level of confidence and expertise, and which clinical diagnostic hypotheses can be tested with these devices.

COHORT STUDY

To address such issues we recently carried out a cohort study [7] involving four hospital medical wards, one gastroenterology outpatient clinic, and 90 general practices in the same geographical area (Lombardy, Italy). After a short standardized training course, one hundred and

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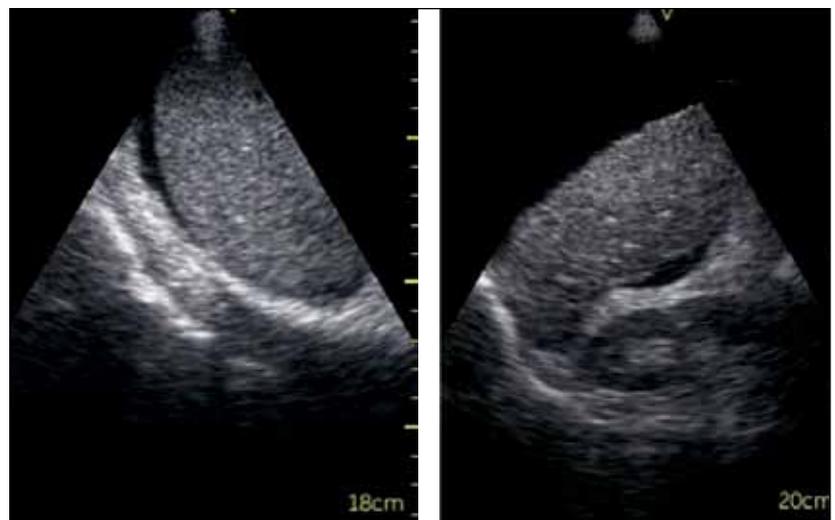


FIGURE 1. Evidence of the presence of fluid around the liver. Left Panel: minimal ascites . Right Panel large ascitic fluid around a macronodular liver.



FIGURE 2. Pleural effusion in the right emithorax. Left Panel: minimal effusion with pulmonary consolidation. Right Panel: severe effusion.

thirty five physicians used PUD to examine 1962 consecutive patients with one of 10 suspected diagnoses, namely ascites, pleural effusion, pericardial effusion, urinary retention, urinary stones, gallstones, biliary-duct dilation, splenomegaly, abdominal mass and abdominal aortic aneurysm. These are common diagnostic questions in both in- and out-patient settings and are generally poorly answered by physical examination alone. They may therefore benefit from the addition of a focused PUD examination.

In the study, each physician decided whether the PUD results were enough to confirm or exclude the diagnostic hypothesis, or whether the case needed further testing.

This study was designed as an impact study whose main outcome was the effect of the introduction of PUD on clinical decision-making and whether overconfidence in PUD results can be excluded.

The physicians participating in the



FIGURE 3. Bladder distention.

study had no previous experience with ultrasound, and attended a short training course, given by an expert in diagnostic ultrasonography. The course included a preliminary lesson (45 minutes) explaining the general technical principles of US examinations, the collection of pertinent images and focused examinations of patients (120 minutes), and a subsequent one-week attendance at the referral hospital with hands-on training with patients.

After this training period, the physicians were able to make a diagnosis based on PUD alone in about two-thirds of the cases. Further testing was found to be necessary in only 37% (645/1734) of the cases. Overall, the adoption of PUD resulted in more than 1000 additional tests (mainly US or CT) being unnecessary, thus simplifying the diagnostic process and lowering the cumulative doses of radiation. In an evaluation of the agreement with the final clinical diagnosis, it was found that only 5% of cases (20 out of 384) were classified as false negatives. However, this misclassification did not lead to any severe complication over a 3-months follow-up period, suggesting that a diagnostic tree based on the use of PUD in initial assessment is reasonably safe.

The possible presence of gallstones (37.2%), ascites (16.6%), pleural effusion (12.9%), urinary stones (13.2%) and bladder retention (11.8%) accounted for more than 90% of the indications for a PUD examination decided by the physicians. As expected there was a wide variation of indications for PUD examination. This heterogeneity mir-

rors the differences in clinical conditions and in the principal symptoms and complaints of in- and out-patients in primary and tertiary settings. It is interesting to note that PUD examinations were mostly used for confirmation — in two thirds of the cases — rather than for exclusion purposes.

When the PUD examination is considered as the index test and further testing as the reference standard, the overall diagnostic accuracy was 89%; the sensitivity 91%; the specificity 83%, the positive likelihood ratio (LR+) 5.4 and the negative likelihood ratio (LR-) 0.11. Even with the possible limitations inherent to the study design, the low LR- supports the use of PUD as a triage test before carrying out other more complex, and more costly, tests. In addition, since patients underwent further testing in the most difficult cases, e.g. when PUD interpretation was judged inconclusive by the examining physician, the accuracy of the PUD examination may even have been underestimated.

CONCLUSION

The findings of this study show that, after a brief period of simple training, a PUD-assisted examination can be successfully used by physicians in various settings for ten common clinical indications and considerably reduces the number of additional diagnostic tests needed. Adding a PUD examination to a physical examination is therefore a promising approach with the potential of reducing waiting times and healthcare costs.

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