

Ultrasound for internists: changing bedside examination

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In this issue of the journal, Touw *et al.* describe the principles of bedside lung ultrasound in a narrative review. Lung ultrasound allows for rapid, non-invasive and bedside patient assessment and the authors believe that lung ultrasound will be the most used imaging technique in dyspnoeic patients in the near future,¹ thereby possibly replacing the stethoscope almost two centuries after its invention by Laennec at the Hôpital Necker in Paris in 1816.

The rise of bedside ultrasound is the result of several developments. The costs of portable ultrasound equipment have decreased, the handling of the equipment has become easy, the quality of the scans has increased and physicians have come to realise how ultrasound can be of benefit for rapid diagnosis and treatment. Cardiologists, gynaecologists and many others use ultrasound routinely. Compared with other imaging modalities, such as computed tomography scanning, bedside ultrasonography is rapidly deployed and noninvasive, and there is no administration of contrast agents or exposure to radiation.²⁻⁴

The scope of bedside ultrasound differs from diagnostic ultrasound, as performed by radiologists. In bedside ultrasound physicians mainly search for dichotomous answers to basic clinical questions raised by the patient's chief symptoms or differential diagnosis, and for this reason the term binary ultrasound (yes or no) is advocated. In this manner ultrasound increases diagnostic accuracy, shortens the time to definitive therapy and supports the clinician in the decision-making process.^{3,5,6}

That bedside ultrasonography can be of use for internists in many types of patients and care settings has been shown in previous studies. Jones *et al.* showed a contribution of ultrasound to medical decision making in critically ill patients with non-traumatic, undifferentiated hypotension. Incorporation of bedside ultrasound led to a more timely and more accurate diagnosis compared with usual care.

Physicians in this study used a seven-step goal-directed protocol to assess the heart for cardiac tamponade, left ventricle function, and right ventricle function and size. Subsequently, the inferior vena cava was assessed to estimate volume status, and the abdomen was examined for the presence of free intraperitoneal fluid or an aneurysm of the abdominal aorta. The average time to complete the ultrasound examination using this protocol was approximately six minutes.⁶ This seven-step protocol is comparable with the focused assessment with sonography in trauma (FAST), which is successfully used in trauma patients.^{2,4} Lung ultrasound can aid physicians in making a rapid diagnosis in patients with acute respiratory failure. In their review, Touw *et al.* describe the Bedside Lung Ultrasound in Emergency (BLUE) protocol by Lichtenstein *et al.* Using this BLUE protocol, physicians can rapidly differentiate between pulmonary oedema, COPD, asthma, pulmonary embolism, pneumothorax and pneumonia with sensitivities and specificities ranging from 81 to 100%.^{1,7} In patients suspected of deep vein thrombosis, Magazzini *et al.* showed bedside ultrasound by emergency physicians was both accurate and safe, allowing rapid discharge from emergency departments and preventing improper treatment with anticoagulants.⁸ Ultrasound also aids physicians in performing invasive procedures, and increases success and lowers the risk for the patient. For example, procedural guidance with ultrasound allows safer drainage in patients with pleural or intra-abdominal fluid, or safe placement of central venous catheters.^{2,3}

Ultrasound is not only of use in the emergency department and the wards; also in the outpatient department the possibilities of ultrasonography for various subspecialties of internal medicine are plenty. Examples include thyroid ultrasonography by endocrinologists, carotid artery intima media thickness measurement by vascular internists, vascular access for dialysis by nephrologists, and musculoskeletal ultrasound by rheumatologists.²⁻⁴

Ultrasound is an operator-dependent technology, and therefore it is paramount that the quality of ultrasound examinations is assured.⁹ Operators should be appropriately trained and certified, and continuous medical education is required to maintain and increase acquired skills. The European Federation of Societies for Ultrasound in Medicine and Biology defined, in accordance with the view of World Health Organisation, practice of ultrasonography on three levels of competence. Level 1 ultrasonographers are able to perform common examinations safely and accurately. Level 2 ultrasonographers are able to recognise and correctly diagnose almost all pathology within the relevant organ systems and can perform ultrasound-guided invasive procedures. Level 3 ultrasonographers perform on an advanced level of practice performing specialised ultrasound examinations and advanced ultrasound-guided invasive procedures, next to teaching and research.¹⁰ These levels of competence are supported by various medical societies, for example the Royal College of Radiologists (United Kingdom) and Deutsche Gesellschaft für Ultraschall in der Medizin (DEGUM, Germany).

The ultrasound training programs vary between different countries and specialities. Countries where ultrasonography is part of the routine practice of internists have structured training programs incorporated in residency training. In Germany, ultrasound is usually trained during residency according to DEGUM standards¹¹ and in Italy, the Italian Society of Internal Medicine organises an ultrasound Summer School for internal medicine residents, allowing them to achieve level 1 and 2 competence during their residency.⁹ Implementation of ultrasonography in undergraduate training increases understanding of ultrasound and improves traditional physical examination skills.^{1,11} In countries without structural ultrasonography training for residents, physicians mostly acquire ultrasound skills by following one of the many ultrasonography courses. For example, Touw *et al.* describe in their review a two-day Intensive Care Ultrasound (ICARUS) curriculum, followed by a practical and theoretical exam, and the program is open for medical specialists and residents in the final stages of their training.¹

As findings during ultrasound are in some ways comparable to findings during physical examination, we propose that internists describe the interpretation of the images as part of the physical examination. However, to assure maximum quality and minimise the risks for patients that accompany the use of ultrasonography (e.g. false-positive or false-negative findings), it is important that each hospital has a proper governance system for all physicians using ultrasound. This governance system should oversee training, certification, education and supervision. For such a governance system to work

optimally, we advocate that hospital organisations facilitate the systematic recording of scans that are acquired at the bedside, in the same way that scans performed by the radiologist and other experts are recorded in the (electronic) patients medical record. This not only allows for structural supervision of level 1 and 2 ultrasonographers, thereby assuring maximum quality of care, but it also facilitates ultrasonographers in keeping a logbook with the number of performed examinations, which is required for continuous education. At the hospital level, it gives insight into the number of physicians using bedside ultrasound.

In conclusion, the bedside availability of ultrasound potentially makes ultrasonography the stethoscope of the 21st century. For optimal use, physicians should undergo structural ultrasound training in medical residency training programs, or during undergraduate training, followed by continuous medical education. Internists should describe the results of their ultrasound examination in the medical record as part of the physical examination. Hospital organisations should facilitate governance by making structurally recording of scans possible.

REFERENCES

1. Touw HRW, Tuinman PR, Gelissen HPMM, Lust E, Elbers PWG. Lung Ultrasound: routine practice for the next generation of internists. *Neth J Med.* 2015;73:100-7.
2. Moore CL, Copel JA. Point-of-care ultrasonography. *N Engl J Med.* 2011;364:749-57.
3. Bosch FH, ter Maaten JC, Geers AB, Gans RO. Binary ultrasonography for the internist: yes or no, that's the question! *Neth J Med.* 2012;70:473-5.
4. Arienti V, Camaggi V. Clinical applications of bedside ultrasonography in internal and emergency medicine. *Intern Emerg Med.* 2011;6:195-201.
5. Arntfield RT, Millington SJ. Point of care cardiac ultrasound applications in the emergency department and intensive care unit—a review. *Curr Cardiol Rev.* 2012;8:98-108.
6. Jones AE, Tayal VS, Sullivan DM, Kline JA. Randomized, controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients. *Crit Care Med.* 2004;32:1703-8.
7. Lichtenstein DA, Meziere GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure: the BLUE protocol. *Chest.* 2008;134:117-25.
8. Magazzini S, Vanni S, Toccafondi S, et al. Duplex ultrasound in the emergency department for the diagnostic management of clinically suspected deep vein thrombosis. *Acad Emerg Med.* 2007;14:216-20.
9. Arienti V, Di Giulio R, Cogliati C, Accogli E, Aluigi L, Corazza GR; Ultrasound SIMI Study Group. Bedside ultrasonography (US), Echocopy and US point of care as a new kind of stethoscope for Internal Medicine Departments: the training program of the Italian Internal Medicine Society (SIMI). *Intern Emerg Med.* 2014;9:805-14.
10. Education, Practical Standards Committee EFoSfUIM, Biology. Minimum training recommendations for the practice of medical ultrasound. *Ultraschall Med.* 2006;27:79-105.
11. Heinzow HS, Friederichs H, Lenz P, et al. Teaching ultrasound in a curricular course according to certified EFSUMB standards during undergraduate medical education: a prospective study. *BMC Med Educ.* 2013;13:84.