Normalising lung ultrasound

During the early 19th century, fascination with measuring the speed of sound underwater ultimately led to the development of SONAR (sound navigation and ranging).[1] These early developments of SONAR underwent major advances in the battle for naval supremacy during the first and second world wars.[1] It was, however, only within the past 60 years that ultrasound for applications in the medical field gained momentum, starting with initial attempts to diagnose brain tumours and abdominal and pelvic masses using large and unpractical ultrasound machines, and leading to the current routine application of ultrasound in disciplines such as obstetrics and gynaecology, cardiology and others with portable hand-held devices.[1] Although ultrasound is a routine part of the diagnostic and therapeutic services provided by radiologists and diagnostic sonographers, the past two decades really saw ultrasound coming full circle back into the hands of treating clinicians at the point of care. Emergency and critical care physicians were early adopters of point-of-care ultrasonography to assist in the rapid diagnosis and treatment of patients with time-sensitive life-threatening illnesses.[2] Currently, point-of-care ultrasonography is embraced as an essential cost-effective bedside tool to improve on the sensitivity of the clinical examination and to perform interventions, such as central line placement or pleural effusion sampling, under direct vision and therefore limiting the risk of iatrogenic complications.[3]

Since air is the 'enemy' of ultrasound, it was initially thought that ultrasound could not be applied for lung imaging. Unlike conventional ultrasound imaging, where the acoustic properties of soft tissue enable the shape of different organs to be visualised fairly accurately, air in normal lungs impedes ultrasound waves.[4] Despite this hindrance, early pioneers of lung ultrasonography noted that normal and diseased lung tissue is associated with certain image artefacts. The ability of clinicians to differentiate normal from diseased lung by interpreting the artefactual pattern made lung ultrasound an attractive tool to respiratory physicians in the management of patients with pulmonary disorders.[4] One of the most prominent artefacts is the hyperechoic pleural line, resulting from ultrasound waves reflected from the pleura.[5] Movement of normal visceral pleura relative to parietal pleura creates 'lung sliding'.[5] Loss of normal lung sliding may therefore indicate air between the visceral and parietal pleura, or lung disease abutting the visceral pleura and impeding pleural movement. Reverberation artefacts of the pleura result in equidistant horizontal lines on the ultrasound image, called A-lines.[6] An increase in lung density, such as with interstitial inflammation or pulmonary oedema, results in loss of A-lines. With interstitial oedema or inflammation, ultrasound waves deflect from denser lung interstitium, creating vertical lines coming from the pleura on ultrasound imaging, called B-lines.[6] B-lines can also be used to qualitatively judge the intrapulmonary water content of the lungs, since the more numerous the B-lines are, the more water the lungs contain.[7]

As respiratory physicians became more adept at lung ultrasonography, it naturally followed for ultrasound to be used in clinical practice when performing diagnostic interventions involving the chest wall, pleural space and lungs.[8] Sub-pleural pneumonia or lung masses are recognised on lung ultrasound as hypoechoic lesions, associated with irregular borders where the mass borders normal lung tissue.[9] It is this ability to identify lung masses abutting the pleura that allows diagnostic samples to be taken by means of fine-needle aspiration or biopsy under ultrasound guidance.[10] The advantages of clinicians performing ultrasound-guided procedures are numerous. It saves time, because diagnostic procedures can be performed at the time of consultation. It is also a cost-effective option that circumvents the need for expensive computed tomography (CT)-guided procedures.[11] The portability of ultrasound machines makes it possible for procedures to be performed wherever patients are located, unlike CT machines, which are not portable and are often unavailable in limited-resource or rural settings. CT machines also expose patients to unnecessary radiation. Ultrasound-guided interventions reduce the risk of complications,[6,12] thereby potentially limiting the risk of litigation. It is easy to learn lung ultrasonography. House *et al*.[13] found that the majority of physicians in a low-resource setting were able to interpret lung ultrasound proficiently after only 1 day of training.

The study by Benbarka *et al*.[14] in this issue of *AJTCCM* further adds to the body of knowledge on the use of ultrasound in performing diagnostic interventions for thoracic masses. The investigators evaluated all cases of thoracic plasmacytoma diagnosed by respiratory physicians at their hospital's pulmonology division over a 12-year period. Plasmacytoma is a rare, frequently unsuspected haematological malignancy that can present with solitary masses in any organ.[15,16] The study demonstrates the utility and feasibility of using chest ultrasound to assist in the diagnosis of plasmacytoma. The availability of cytopathologists on site to rapidly analyse cytology samples increases diagnostic certainty. The ability of respiratory physicians to perform ultrasound of the chest and use this modality to guide diagnostic procedures ultimately provides a one-stop service for patients with accessible lung, pleural or chest wall masses. As part of a patient-centred service, rapid on-site evaluation (ROSE) has the potential to provide the patient with a diagnosis and management plan immediately after the procedure. This is an important consideration in low socioeconomic settings where the cost incurred by patients to attend healthcare establishments can be a considerable obstacle. Reducing the turnaround time between sampling and reporting of results is an important consideration in settings where loss to follow-up may be a concern. The growing recognition that lung ultrasound can assist in the rapid diagnosis of specific respiratory diseases makes it an important modality that should be normalised in the clinical setting.[17]

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