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REVIEW

Pleural ultrasound for clinicians☆

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Abstract Pleural ultrasonography is useful for identifying and characterizing pleural effusions, solid pleural lesions (nodules, masses, swellings) and pneumothorax. Pleural ultrasonography is also considered the standard care for guiding interventionist procedures on the pleura at the patient's bedside (thoracentesis, drainage tubes, pleural biopsies and pleuroscopy). Hospitals should promote the acquisition of portable ultrasound equipment to increase the patient's safety.

PALABRAS CLAVE
Ecografía torácica;
Derrame pleural;
Neumotórax;
Toracocentesis

Ecografía pleural para clínicos

Resumen La ecografía pleural es útil para identificar y caracterizar derrames pleurales, lesiones pleurales sólidas (nódulos, masas, engrosamientos) y neumotórax. Asimismo, se considera el estándar asistencial para guiar procedimientos intervencionistas sobre la pleura a la cabecera del paciente (toracocentesis, tubos de drenaje, biopsias pleurales y pleuroscopia). Los hospitales deberían favorecer la adquisición de equipos de ultrasonido portátiles en beneficio de la seguridad del paciente.

Background

In recent years, there has been considerable growth in the use of ultrasonography as a diagnostic tool by nonradiology clinicians. Advances in technology have contributed to this growth, not only providing significant improvements in image quality but also developing portable devices for use

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at the patient's bedside.[1] The primary advantages of ultrasonography over plain radiography or computed tomography (CT) include the lack of radiation, its portability and real-time imaging. As with any scan, ultrasonography presents a learning curve for the clinician; however, the learning curve is relatively short. If there were an area of medicine that combines the simplicity of ultrasound investigation and diagnostic yield, it would be pleural diseases. In this review, we will address the application of ultrasonography in detecting pleural effusion (PE) and pneumothoraces, as well as the performance of various invasive pleural procedures.

Key concepts and equipment

An ultrasound device works by applying electric pulses to a piezoelectric crystal (transducer), producing ultrasound waves that penetrate tissue at variable speeds, depending on the tissue's density and elasticity (acoustic impedance). These waves reflect off anatomical structures and return to the transducer where they generate another electric signal, which a processor uses to generate a grayscale digital image. Bone and air are poor conductors of ultrasound. The term ''ultra'' refers to the fact that the wave frequency (cycles per second) is greater than 20,000 Hz or 20 kHz, the upper audible limit for humans.[1,2] In clinical practice, ultrasound frequency is measured in megahertz (MHz or 1,000,000 Hz).

Transducers

Transducers or probes are classified according to the ultrasound frequency they generate and the arrangement of the piezoelectric crystals,[2] creating low-frequency (2–6 MHz) and high-frequency (7–12 MHz) transducers. The former provide greater depth but lower image quality, whereas the latter provide greater image resolution but reduced depth. A distinction can also be made between (a) linear transducers, with crystals arranged in a straight line that transmit ultrasound beams in a perpendicular manner and that create a rectangular image (for scanning vascular and skin structures); (b) convex transducers, with a curvilinear arrangement of crystals that create a wedge-shaped image (for abdominal and obstetric examination); and (c) phased-array transducers, which create a triangular or fan-shaped image and have a smaller area, allowing an intercostal approach (cardiac and thoracic examination). To examine the presence of pleural effusion, low-frequency phased-array transducers can be used by applying them perpendicularly to the chest. High-frequency linear transducers are selected for chest wall and parietal pleura examinations (e.g., checking for thickening, pneumothorax and intercostal vessels) and are used in the transverse and sagittal positions on the intercostal area (Fig. 1).[2] Conventionally, transducers have a notch, groove or marker on one of their edges, corresponding to a signal located on the upper-left edge of the screen, providing adequate spatial interpretation of the image.

Ultrasound device

A number of settings on the ultrasound device need to be adjusted at the start of the examination, such as scan depth, gain (image brightness), time-gain compensation (differential brightness control at different depths) and focus (specific area in which greater image definition is intended). For chest ultrasounds, scan depth is normally set

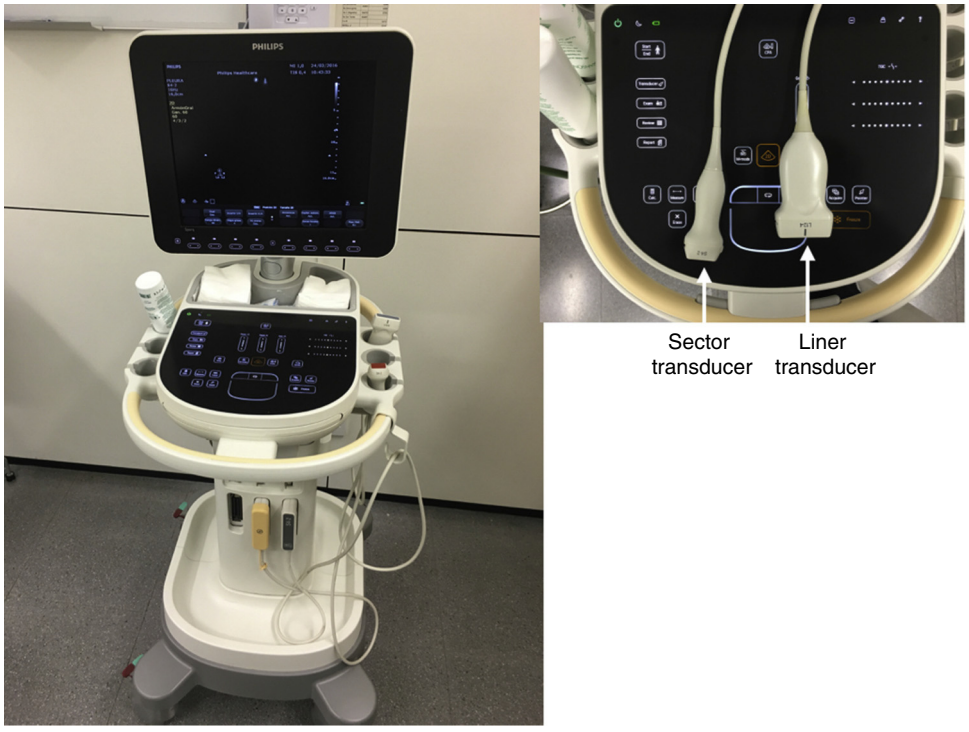

Figure 1 Ultrasonography device with phased array and linear probes for thoracic examination.