EFSUMB Course Book, 2nd Edition

Editor: Christoph F. Dietrich

Ultrasound of the chest

Gebhard Mathis[1], Annia Schreiber[2], Zeno Spârchez[3], Giovanni Volpicelli[4]

[1]Praxis for Internal Medicine, Rankweil, Austria.

[2]Division of Respirology, Department of Medicine, University Health Network, Toronto, Canada.

[3]Institute for Gastroenterology and Hepatology, Department of Ultrasound. "Iuliu Hatieganu", University of Medicine and Pharmacy, Cluj-Napoca, Romania.

[4]Department of Emergency Medicine, San Luigi Gonzaga University Hospital, Torino, Italy.

Corresponding author:

Gebhard Mathis, MD., FCCP.

Praxis for Internal Medicine, Rankweil, Austria

Email: gebhard.mathis@cable.vol.at

Technical requirements

Sonographic examination of the chest wall and axillary/supraclavicular region generally requires a linear array probe using frequencies between 5 to 10 MHz. For pleural and peripheral pulmonary lesions, sector scanners are more suitable for intercostal access to the pleura and lung through the narrow intercostal spaces. Tilting and angulation of the probe provides a good view of most parts of the pleura and of underlying pulmonary consolidation. Convex arrays provide better images and give a greater field of view when the examiner subtracts the rib shadows from the picture. For sonographic examination of the pleura and lung, frequencies between 3.5-15 MHz are recommended. For daily clinical use in chest sonography, the best combination of probes is a 3.5-5 MHz sector or curved array probe and a small parts linear scanner with a frequency of 5-12 MHz (15 MHz, if necessary). This combination is used in many other settings, e.g. abdominal, vascular and small parts ultrasound [(1)].

Examination technique

Chest sonography is a point of care ultrasound. Thus, the examination is tailored to the patient's symptoms, e.g. pain or dyspnoea. The position in which the patient is scanned depends on the clinical question. In a systematic examination, usually the dorsal and lateral images are obtained with the patient sitting, whereas the supine position is used for visualising the ventral side. Raising the arms and crossing them behind the head causes the intercostal spaces to be extended and facilitates access. The examiner is able to visualise the region behind the shoulder blade if the patient puts their hand on the contralateral shoulder. The transducer is moved along the intercostal space in a dorsal to ventral direction in both longitudinal and transverse planes. Rotating the probe in different positions provides the examiner with a three-dimensional image. During every stage of the examination, the user should determine the movement of the pleura in relation to respiration, the so-called sliding sign [Figures 1 and 2].

Figure 1 **Linear probe placed intercostally in an oblique view (a). The right arm is elevated behind the head or positioned on the contralateral shoulder. The intercostal spaces are extended and the scapula is turned. Corresponding sonographic view with the sliding line of the visceral pleura (b).**

a

b

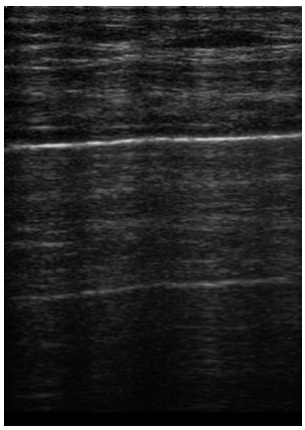
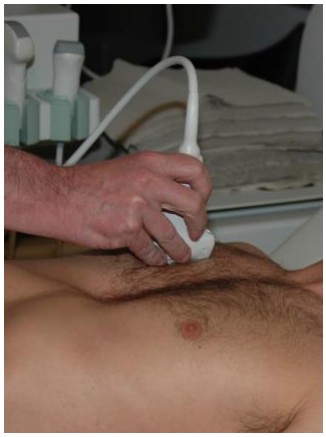
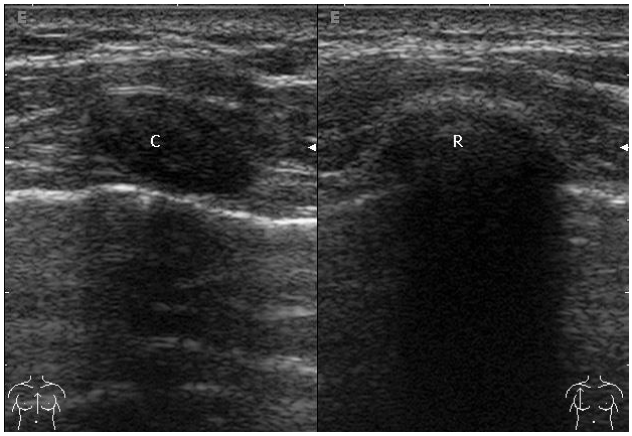


Figure 2 Linear probe in an anterior longitudinal scan (a). Corresponding sonographic image, the sliding line of the visceral pleura can be seen (b) below the cartilage (C) of the ribs (R).

a



b



The diaphragm is examined through the subcostal section of the abdomen via the transhepatic route on the right and to a lesser extent through the spleen on the left [Figure 3]. The axilla should be examined in the supine position with the arm abducted over the head. Supraclavicular access allows the investigator to view the region of the brachial plexus, the subclavian vessels and the lung apex. From a suprasternal approach, the anterior upper mediastinum can be viewed. Immobile and intensive care patients are examined by turning them to the oblique position in the bed [(1)].

Figure 3 **Transhepatic examination. Convex probe placed subcostally from the right (a). Corresponding sonographic image, lung is indicated by a mirror artefact above the diaphragm (D) (b).**

a

b

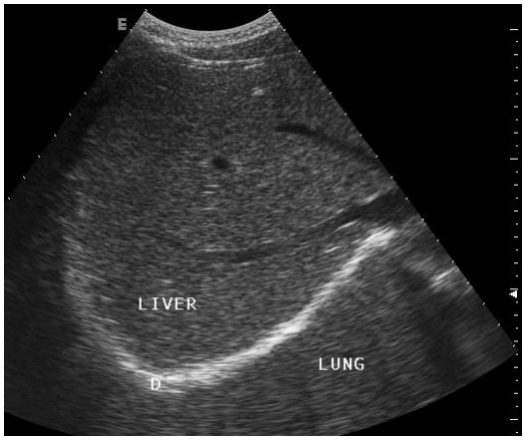
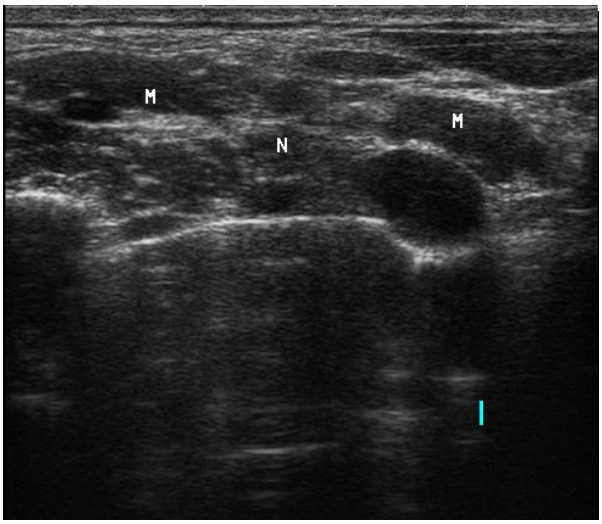


Figure 4 **Examination of the supraclavicular region. Linear probe placed longitudinally on the lateral base of the neck (a). Corresponding sonographic image (b). Brachial plexus (N); Scalene muscles (M).**

a

b



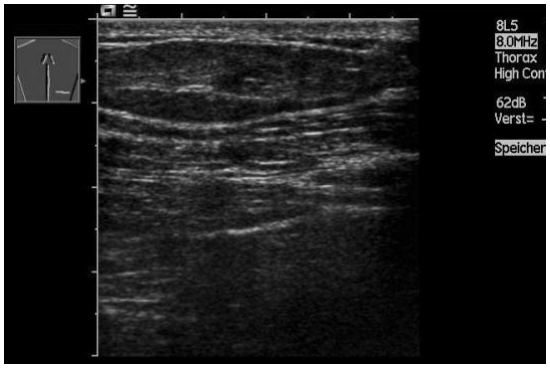
Chest Wall

Soft tissue lesions

Suspicious or unclear findings during palpation of the chest wall should be initially examined by ultrasound. In most cases the examiner will find lymph nodes, which are the most

clinically relevant finding. However, haematomas and lipomas are also visualised by ultrasound. Haematomas are echo-free or hypoechoic and show blurred internal echoes. The echogenicity of haematomas depends on the amount of extravasated blood and the stage of organisation. Lipomas have a similar but largely hypoechoic ultrasound picture. Their echogenicity depends on the fat content of cells [Figure 5]. In cases of painful swelling in the region of the axilla, a sweat gland abscess can be differentiated from a lymph node.

Figure 5 Palpable mass on the back. An oval encapsulated lesion is visualised, a typical lipoma.



Lymph nodes

Reactive and inflammatory lymph nodes are a very common finding in the axilla and supraclavicular fossa. On ultrasound, their typical shape is oval or triangular, some are long and thin [Figure 6]. The so-called hilum fat sign is found in the centre of reactive lymph nodes. This echogenic centre becomes larger during the healing process of inflammatory lymph nodes.

Malignant lymphomas also appear echolucent. They are rounded, sharply bordered and expansive, but in most cases they are non-infiltrating. Although some sonomorphological criteria exist to help distinguish the aetiology of lymph nodes, they may have similar appearances despite having different origins. If immediate treatment is required, ultrasound guided needle biopsy may help to make a swift diagnosis. Alternatively, regular follow up scans may provide reassurance depending on the clinical course.

The diagnosis or exclusion of lymphatic metastatic disease is a question frequently raised by clinicians. Lymph node metastases appear as round to oval, inhomogeneous structures with irregular margins and irregular vascularisation [Figure 7]. However, they typically show extracapsular growth into irregular borders and diffuse infiltrating growth into vessels and the surrounding tissue. Necrosis, calcification or partial lymph node infiltration may produce an inhomogeneous ultrasound pattern.

Routine ultrasound evaluation of supraclavicular lymph nodes reveals suspicious lymph nodes in a high number of patients with lung cancer. High-resolution ultrasound is superior to CT in the detection of pathological lymph nodes, especially of non-palpable lymph nodes. Ultrasound guided biopsy can prove malignancy and thereby a N3 or M1 stage. Thus, more invasive and expensive procedures can be avoided. Non-palpable lymph nodes and metastatic disease in reactive lymph nodes can be detected [(2)].