

Professional Standards in Thoracic Ultrasound – EFSUMB Position Paper

Professionelle Standards in der Thoraxsonografie – Positionspapier der EFSUMB

Authors

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ABSTRACT

This position paper of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) on professional standards in thoracic ultrasound is a supplement to EFSUMB's previously published professional standards in medical ultrasound – general aspects. The paper represents a position across the different medical professions within EFSUMB regarding optimal standards for the performing and reporting of thoracic ultrasound examinations by any professional ultrasound practitioner. It describes aspects that ensure procedure quality, effectiveness, efficiency, and sustainability in the application of thoracic ultrasound. The paper provides recommendations regarding safety and the indication for thoracic

ultrasound examinations, requirements for examination rooms, structured examinations, systematic reporting of results, and the management, communication, and archiving of ultrasound data.

ZUSAMMENFASSUNG

Dieses Positionspapier der European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) zu professionellen Standards in der Thoraxsonografie ergänzt die zuvor von der EFSUMB veröffentlichten professionellen Standards im medizinischen Ultraschall – Allgemeine Aspekte. Das Papier vertritt die Position der verschiedenen medizinischen

Fachrichtungen innerhalb der EFSUMB hinsichtlich optimaler Standards für die Durchführung und Befundung von Ultraschalluntersuchungen des Thorax durch professionelle Untersucher. Es beschreibt Aspekte, die die Qualität, Effektivität, Effizienz und Nachhaltigkeit des Verfahrens bei der Anwendung der Thoraxsonografie sicherstellen. Das Papier enthält Empfehlungen zur Sicherheit und Indikationsstellung von Ultraschalluntersuchungen des Thorax, zu Anforderungen an Untersuchungsräume, zu strukturierten Untersuchungen, systematischer Befundung sowie zur Verarbeitung, Kommunikation und Archivierung von Ultraschalldaten.

1. Introduction

The European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) is a federation for everyone practicing professionally within the field of ultrasound (US). EFSUMB's objectives include proposing standards, giving advice for education, training, and clinical applications including quality of care and safety, and promoting the science, research, and development of ultrasound. In 2022, EFSUMB published its first position paper on professional standards for general aspects in medical ultrasound. The position paper presented standards across the different medical professions within EFSUMB regarding optimal standards for the performance and reporting of ultrasound examinations by any professional ultrasound practitioner¹ including general recommendations related to safety and indications for ultrasound examinations, requirements for examination rooms, structured examinations, systematic reporting of results, and the management, communication, and archiving of ultrasound data [1]. While many of the general aspects covered by the EFSUMB professional standards paper can be applied directly to most of the different subtypes of medical ultrasound, some special considerations and customized professional standards may be warranted when performing a more specific type of medical ultrasound.

A working group of European thoracic ultrasound (TUS) experts has been writing a document presenting the EFSUMB minimal training requirements in TUS, while trying to accommodate the different setups across Europe [2]. A logical extension of training requirements is the description of specific professional standards by the same working group of leading experts in TUS, which is an extension of the EFSUMB position paper on general professional standards in medical ultrasound and the EFSUMB minimal training requirements in TUS [1].

In this paper, TUS is defined as transthoracic medical ultrasound used to visualize and provide clinical information regarding the chest wall, parietal pleura, pleural cavities, visceral pleura, lung tissue, diaphragm, upper and anterior mediastinal compartments, as well as related anatomical structures (e.g., lower neck, upper abdomen, pericardium) [3, 4]. In the literature, many other terms have been used or they overlap with this definition (e.g., chest sonography, lung ultrasound, pleural ultrasound), but the

term TUS has been chosen to cover the anatomical structures and ensure consistency in the nomenclature. TUS can be performed at different levels, depending on the operator, with or without a point-of-care approach [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17].

1. For example, specialists in respiratory medicine, emergency medicine, family medicine, anesthesiology, intensive care, pediatrics/neonatology, radiology, internal medicine, cardiology, oncology, as well as physiotherapists, respiratory therapists, and other physician or non-physician medical professionals with formal training in thoracic ultrasound.

In the context of these recommendations, some important points should be noted:

- In most clinical settings where TUS is performed, the examiner is seeking to answer a specific clinical question and will focus his/her examination on this question. An extensive, more explorative examination is rarely performed. Regardless of the approach, the TUS examination should always be performed and reported in a systematic manner.
- Diagnostic medical ultrasound of the heart (e.g., echocardiography) is not included as part of TUS, since this is traditionally seen as a separate discipline with its own recommendations and professional standards.
- EFSUMB's previous training recommendations from 2008 describing chest sonography included TUS, endoscopic ultrasound (EUS), and endobronchial ultrasound (EBUS) [18]. Since the clinical use of all modalities has rapidly expanded since then, this paper will only cover transthoracic ultrasound mirroring the training recommendations [2].

The aim of this paper is to provide professional standards for TUS, while still acknowledging that the clinical use of TUS differs, is still rapidly developing, and has many overlaps with other forms of medical ultrasound. Hence, the general TUS aspects described below may not be comprehensive for all given diverse uses of ultrasound of the thorax.

► **Table 1** Overview of general TUS indications.

Diagnostic TUS	TUS-guided procedures
- Assessment of pathology in the chest wall and related structures - Assessment of parietal pleura and the pleural cavity (e.g., effusion, pneumothorax, pleural masses) - Assessment of visceral pleura (e.g., appearance, movement, and presence of B-lines and/or comet-tail artifacts) - Assessment of lung consolidation in contact with the visceral pleura - Assessment of the diaphragm and diaphragmatic function - Assessment of pathology in the anterior and upper mediastinum - Assessment of the presence of intercostal arteries prior to intervention - Reassessment and monitoring of treatment response - Assessment of pleurodesis	- TUS-guided needle aspiration of pleural effusions and other thoracic fluid collections - TUS-guided pleural drain or catheter placement - TUS-guided trocar insertion for thoroscopic procedures - Transthoracic ultrasound-guided lung drain insertion (e.g., for lung abscess) - Transthoracic ultrasound-guided biopsy (e.g., core biopsy, needle aspiration biopsy) - TUS-guided nerve blocks (e.g., intercostal nerves) - TUS-guided ventilatory strategy (prone positioning, positive end-expiratory pressure (PEEP) titration)

2. Indications for TUS

There are many indications for TUS and these may include diagnostic and/or interventional procedures. TUS may be performed as first-line imaging, often using the point-of-care approach at the bedside, or as second-line imaging after chest X-ray, CT, or PET/CT has identified abnormalities. TUS may have many different indications in different settings and specialties. ► **Table 1** provides an overview of some of the most common indications for the different uses of TUS.

Generally, ultrasound practitioners should meet the training and competency requirements as stated in our previous paper. Non-image-guided interventions in the thorax are considered obsolete due to the increased risk of procedure failure and complications.

Advanced TUS modalities such as elastography and contrast-enhanced ultrasound (CEUS) are not mentioned specifically in the table since the clinical use of these techniques is still mainly limited to specialized centers [19, 20, 21, 22, 23, 24, 25].

Ultrasound practitioners need to know when supplementary imaging is warranted or when other imaging or invasive procedures should be performed instead of TUS [4, 17]. Diagnostic TUS assessment of the lung parenchyma and mediastinum has its clear limitations and cannot be used to assess the entirety of these anatomical areas. Furthermore, imaging modalities and/or invasive procedures other than TUS are more accurate for N- or M-stage in the TNM staging process of tumors [26]. Therefore, ultrasound practitioners performing diagnostic TUS and TUS-guided invasive procedures need to understand and be aware of the roles of other diagnostic and interventional techniques, such as CT-guided biopsy, thoracoscopy, bronchoalveolar lavage, transbronchial forceps biopsy, transbronchial cryobiopsy, EUS, EBUS, radial EBUS, video-assisted thoracic surgery (VATS)/medical thoracoscopy, and relevant clinical practice guidelines for the specific clinical context [27].

3. Special considerations when organizing a TUS service

The general EFSUMB principles and recommendations for the organization of a medical ultrasound service (e.g., training, mentoring, access to previous imaging, access to clinical records, delegation of tasks) also apply when organizing a TUS service [1]. Some more special considerations when organizing a TUS service are mentioned below.

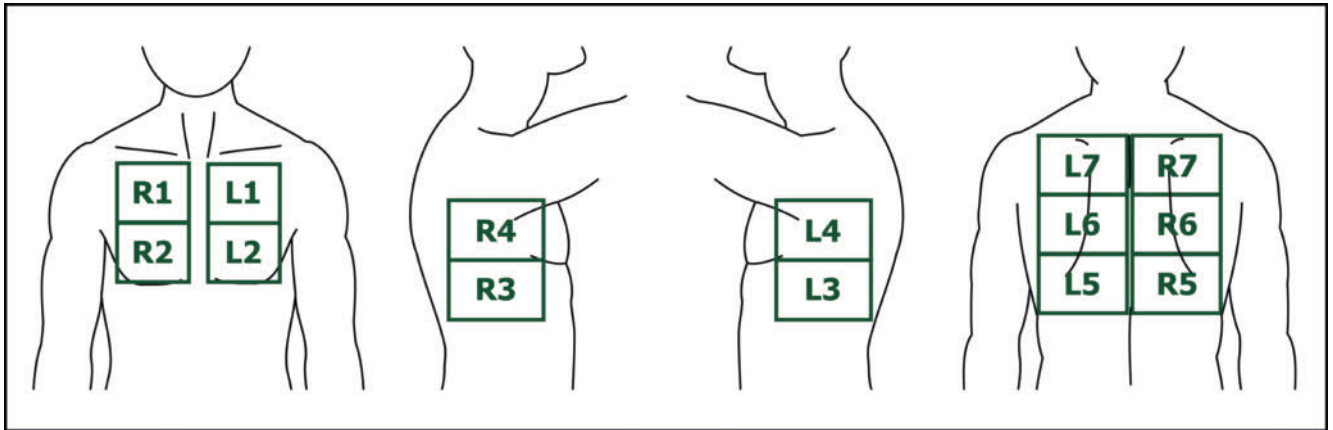
When organizing a TUS service, it is of paramount importance to define the level of expertise. For example, there is a significant difference between a service that is comprehensive and aims to provide all aspects of TUS, a multidisciplinary service that is performed in close collaboration with other departments, and a more basic, focused service.

A comprehensive TUS service will be limited to specialized centers and multidisciplinary centers. However, TUS is much more widely used in many settings and different medical specialties. It is, therefore, important to define the level of expertise in a less specialized setting and to ensure that it is clear when referral to a more specialized center is warranted. The collaboration between different TUS centers or other healthcare professionals should be formalized with defined patient pathways to ensure optimal diagnostic and treatment pathways as well as continuous learning [28, 29]. Several studies have described tele-solutions to provide and support real-time guidance on image acquisition and clinical integration [28, 29, 30, 31, 32].

4. TUS scanning room and setting

We will focus on the setting in which TUS is performed but will not provide detailed information regarding spatial designs and sizes of dedicated US rooms for outpatients, ambulatory patients, and bedridden patients or regarding the performing of US-guided interventions, as this information has been previously published [1].

Apart from performing TUS in a dedicated US or interventional room, TUS may also be performed in less optimal settings (e.g., limitations regarding light, space, sterility). Such settings include



► **Fig. 1** Systematic TUS 14-zone scanning protocol (adapted from Laursen et al. [35, 36, 37]).

the prehospital setting, some intensive care units (ICU), hospital wards, operating rooms, endoscopy suites and uses include the assessment of patients in isolation or neonates. Despite the challenges of performing TUS in these settings, ultrasound practitioners should do whatever is feasible to improve the scanning conditions (e.g., dimming the lights, ensuring sufficient space for the US machine and the examination, ensuring sufficient space and tables if supplementary invasive procedures are to be performed). Additionally, when operating outside a dedicated ultrasound scanning room, patient privacy should be ensured, for example, with moveable screens or curtains.

In many of the described settings, it will not be feasible or safe to transfer the patient to a dedicated TUS room, but the ultrasound practitioner should always consider whether the risks of an inadequate TUS examination or invasive procedure in a less ideal environment are justified.

5. TUS safety and hygiene

The recommendations for the safe use of TUS recently published by the EFSUMB Safety Committee should be considered in training and in clinical practice [33].

All ultrasound systems in hospitals will undergo a general safety check for electrical compatibility. The ultrasound practitioner should have sufficient training to choose the most optimal transducer and setting and to perform the requested examination. The transducer should be cleaned according to the manufacturer's manual between patients, and the entire system should also be disinfected according to the manufacturer's manual if the system has been exposed to a contagious patient or used in a high-risk setting. For TUS-guided interventions, a (semi)sterile approach is frequently necessary including the use of a sterile cover for the ultrasound transducer.

These principles are outlined in more detail in a World Federation for Ultrasound in Medicine and Biology (WFUMB) position statement, but local guidelines may vary [34].

6. Structured TUS examination

Choice of scanning protocol

Several TUS protocols have been described and validated for a wide range of different clinical settings, but there is no international consensus on a single, multi-purpose protocol [4, 16, 35]. The choice of TUS protocol to assess a given patient will depend on the clinical setting and the clinical question. Regardless of the choice of protocol, it is important to stress that use of TUS should be in accordance with international, national, or local clinical practice guidelines. Despite the lack of consensus, protocols for many clinical questions (e.g., pneumonia, edema, pulmonary embolism) are based on the assessment of several predefined scanning zones on the chest. The number of zones and whether the entire chest surface is assessed varies significantly [4, 35] and often only one area of the chest is examined in a targeted manner if a specific issue is being addressed. An example of a TUS protocol based on assessment of 14 scanning zones is given in ► **Fig. 1** [36, 37]. Similarly an example of a TUS protocol for assessment of critically ill supine patients in an intensive care setting including 12 zones (2 anterior, 2 lateral, 2 posterior on each side) is given in ► **Fig. 2** [38].

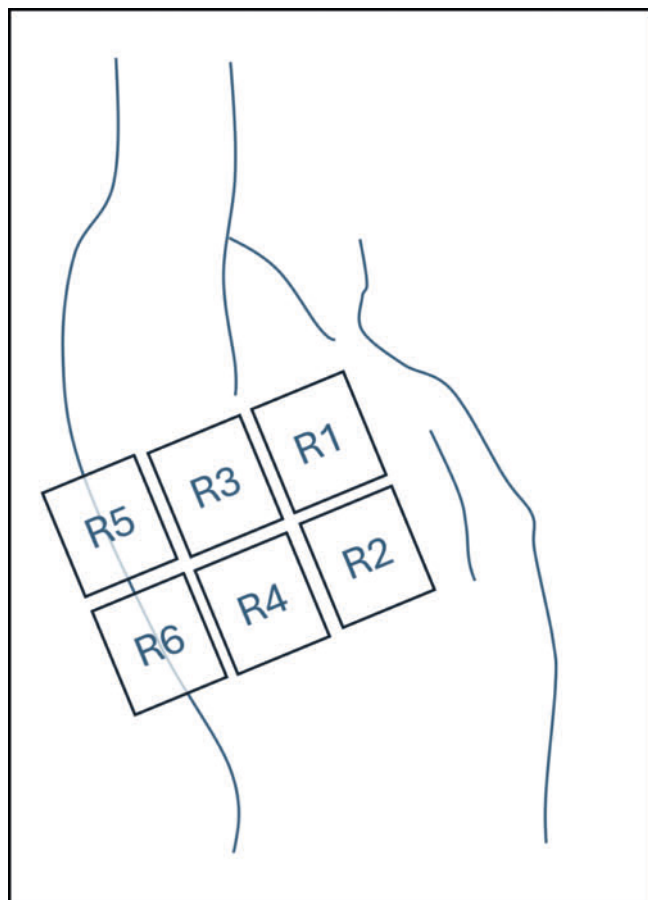
► **Table 2** highlights the minimum recommended standards for TUS protocols prior to their use and implementation. ► **Table 3** highlights aspects that the ultrasound practitioner needs to consider when using a specific TUS protocol in each clinical setting.

TUS approach

Whether TUS is performed in a targeted or more comprehensive manner will depend on the given indication for the examination (► **Table 1**) and on whether the TUS examination is aimed at assessing the entire chest surface and relevant adjacent structures (e.g., supraclavicular region, axillary region, relevant mediastinal compartments, pericardium) or a targeted area as an extension of other available imaging and diagnostic tests (e.g., CT, PET).

TUS – equipment

The US machine used for the examination should provide images of sufficient quality to address the clinical question being asked



► **Fig. 2** Systematic TUS 12-zone scanning protocol for use in a supine patient in an intensive care setting (adapted from Mongodi et al. [38]).

and the probe selection should also depend on this. In some cases (e.g., transthoracic assessment of the mediastinum, intensive care setting) transducers with a narrower “footprint” will be more useful (e.g., phased-array, micro convex).

In addition to B-mode, M-mode, color Doppler imaging, elastography, contrast-enhanced ultrasound (CEUS), and image fusion also have several clinical uses when performing TUS. Several of these modalities should be available when performing TUS, but factors such as setting, other equipment factors (e.g., mobility, access to remote real-time supervision), and immediate accessibility to equipment will also have an impact on the choice of US machine. When TUS is performed using a US machine with limited modalities, the operator must be familiar with equipment limitations and when there is a need to repeat the TUS examination using better equipment or a need to refer the patient to another department/center proficient in more advanced TUS techniques and with access to more ideal equipment.

TUS – patient positioning

For many TUS indications, assessment of the patient in a sitting position is optimal, but assessment of the patient in a supine position may be required in specific settings (e.g., the intensive care setting) and indications (e.g., pneumothorax assessment). Additionally, altering patient position during the assessment may also provide additional clinical information and will be needed for some assessments (e.g., abduction of arm to facilitate assessment of areas adjacent to or at a depth with respect to the scapulae).

TUS examination technique – general approach

Depending on the indication, a typical TUS examination will involve assessment of the chest wall, parietal pleura, pleural cavities, visceral pleura, and the lungs. The assessment can be performed either as an assessment of each individual intercostal space using anatomical landmarks (e.g., anterior/posterior axillary lines) or assessment of the intercostal spaces in predefined

► **Table 2** Minimum recommended standards prior to implementing a TUS protocol in clinical practice.

Aspect	Comment
Protocol description	The description of the TUS protocol should have sufficient detail to allow accurate and systematic replication
Diagnostic accuracy and clinical impact	All TUS protocols should have been prospectively validated in diagnostic accuracy studies and/or studies assessing clinical impact
Clinical setting	The intended clinical setting of the protocol should be equivalent to the one in which evidence-based validation was performed
Clinical questions	The clinical question on which the TUS examination should focus should be short, clearly defined, and preferably dichotomous
Clinical integration	TUS findings (normal & abnormal) should be well-defined and in accordance with: 1. relevant clinical practice guideline(s) 2. approach used in studies validating the protocol
Training and competency assessment	In accordance with EFSUMB training recommendations for TUS, ideally using a training program and competency assessment tools specifically developed and validated for the specific protocol

► **Table 3** Aspects to consider as an ultrasound practitioner when choosing a TUS protocol.

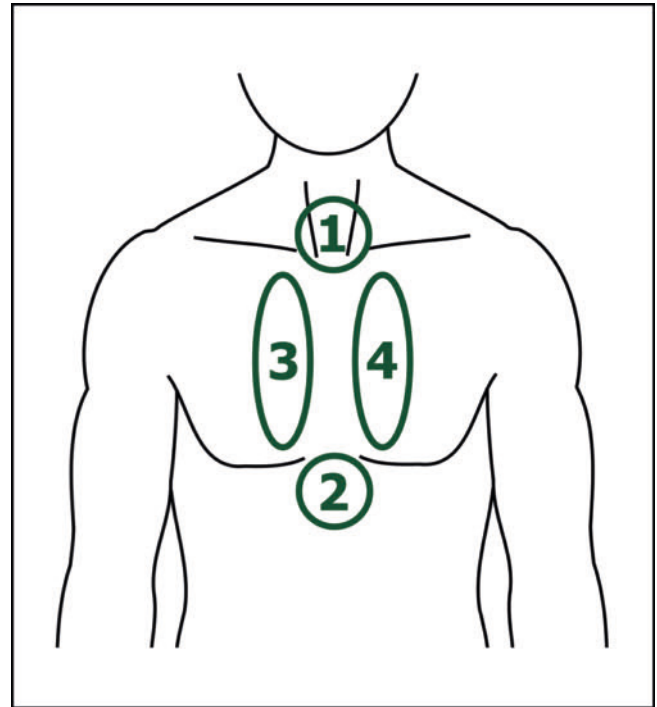
Aspect	Comment
The clinical setting	Consider whether the setting (e. g., prehospital, emergency ward, outpatient clinic, intensive care) is the same as the one in which the TUS protocol was validated
The clinical scenario	Consider whether the clinical scenario (e. g., acute respiratory failure, trauma, post-procedural) is the same as the one in which the TUS protocol was validated
The patient population	Consider whether the patient population of the given setting is not significantly different from the patient population in which the protocol was validated (e. g., prevalence of co-morbidities and diseases)
The US equipment	Consider whether the US equipment is not significantly inferior to the US equipment used for the validation of the protocol (e. g., handheld US versus non-handheld US)
The focused question(s)	Consider whether the clinical question(s) (e. g., presence or absence of pneumothorax) is similar to the one in the validated protocol
Incidental findings	Ensure an organizational setup and predefined pathway for how to handle incidental finding(s) during a TUS assessment
The clinical integration	Consider whether the clinical integration is well-described and in accordance with relevant clinical practice guidelines and the approach used in the studies validating the protocol

scanning zones. Both scanning principles are sufficient if a systematic approach is used. At a given institution or organization, it may be helpful to use the same general approach for all TUS examinations, since this will facilitate the same principles and nomenclature for TUS reporting and documentation. Using the same “TUS language” will limit the risk of misunderstanding and facilitate learning and feedback between different competency levels and departments. Since diagnostically relevant parameters such as the pleural line thickness or the number of B-lines per scanning area are strongly dependent on the type and frequency of the ultrasound probe and machine settings, a standardized TUS protocol with specifications on preset parameters and transducer selection should be used in every institution or organization [39, 40, 41, 42].

When the chest is assessed at a given intercostal space or zone, the transducer should initially be placed with the “orientation marker” located cranially, thereby assessing the longitudinal/vertical appearance of the given intercostal space. Once the relevant anatomical structures have been identified and assessed, the transducer can be rotated counterclockwise to avoid the ribs and visualize the entire pleural line in the given intercostal space (transverse scan in the intercostal space). Whether all the intercostal spaces or only selected areas should be assessed during a diagnostic TUS assessment will depend on the indication.

TUS examination technique – supplementary views and adjacent structures

When using the general TUS approach described above, the diaphragm will typically also be visualized when the most caudal areas of the chest are scanned. Dedicated visualization of the diaphragm can often be achieved by scanning the upper abdomen, and using abdominal structures (e. g., liver, spleen) as acoustic windows to assess the diaphragm and its movements. Several techniques and measurements have been described for assessing the diaphragm, without a single technique or approach being preferred or internationally recommended [3, 4, 20, 43, 44, 45, 46].



► **Fig. 3** Views for transthoracic assessment of the mediastinum. 1: Suprasternal view; 2: Infrasternal view; 3: Right parasternal view; 4: Left parasternal view.

Apart from assessing the diaphragm, the supplementary abdominal views can also be used to assess the posterior phrenic recesses and the presence of lower lobe consolidation.

Supplementary assessment of the supraclavicular area enables visualization of the lung apex and relevant structures at the base of the neck, in particular the supraclavicular N3 lymph node stations in patients with (suspected) lung cancer [47, 48, 49]. The supraclavicular area is best assessed with a high-frequency linear

► **Table 4** Recommended content of a TUS examination report.

1.	Institutional and ultrasound practitioner identification
2.	Patient identification
3.	Date and time of TUS examination
4.	Indication for the TUS examination
5.	Relevant case history and clinical information
6.	Diagnostic questions to be solved by the TUS examination
7.	Scanning conditions incl. any limitations (e.g., patient positioning, structures not identified)
8.	Description of US appearance of structures and any identified pathologies
9.	Summary of findings and interpretation (incl. diagnoses and suspected diagnoses): ▪ Answering the clinical question(s) raised ▪ Listing other pathologic findings in order of their clinical relevance ▪ Findings in the remainder of the examined areas
10.	Diagnostic and/or therapeutic consequences, including any suggestions for further diagnostic workup or follow-up

transducer, and the assessment should include assessment on two planes (longitudinal and sagittal).

TUS's role as a tool for assessment of the mediastinum is generally limited. In selected cases, TUS assessment of the prevascular/upper mediastinal compartments can have a clinical use, especially for procedural guidance in the form of US-guided biopsy [50, 51]. The optimal scanning technique (e.g., patient position, choice of transducer) will depend on which mediastinal compartment is assessed and the type of pathology, hence no single approach is optimal. Generally, para-, supra-, and infrasternal views can be used (► **Fig. 3**), with the patient in the supine position.

Changing from a supine position to a position in which the patient is lying on their side may result in slight displacement of the structures in the anterior mediastinum thereby facilitating the parasternal views. The suprasternal view can be facilitated by placing a pillow between the patient's scapulae to ensure better dorsal flexion of the patient's head and neck. The suprasternal view is generally best obtained using a transducer with a small footprint.

7. Acquisition and archiving of TUS images and cine-loops

It is recommended that images showing pathology are always stored either as still images or (preferably) as cine-loops. If the request for the examination includes a specific finding, for instance: "is there pleural effusion on the right side?", an image of this area should also be stored even if there is no pleural effusion. For interventional procedures, an image of the pathology should be stored and if possible, also an image with the needle or catheter in the pathology. The images or cine-loops should be labelled with the anatomical position, preferably by using the pictograms of the system [1]. The obtained TUS images and cine-loops can be stored either in a Picture Archiving and Communication System (PACS) or locally in the ultrasound system, but the latter has limited capacity. In some countries it is also possible to store the ima-

ges in the electronic medical report system – this will depend on local procedures. It is important to adhere to national rules regarding documentation and archiving [1].

8. TUS reporting

The reporting style will depend on whether the TUS examination is performed by the clinician directly responsible for the patient's management or by an ultrasound practitioner who must report the result of the TUS examination to another physician responsible for the patient's management. Generally, the principles for medical ultrasound reporting described in the EFSUMB professional standards for general aspects in medical ultrasound also apply for TUS reporting [1]. A structured approach using templates and text modules is recommended regardless of medical specialty. When reporting, cautious interpretation of the findings is advised and should not predetermine an absolute diagnosis (e.g., patient has lung cancer) but rather remain in relation to the method used (e.g., typical sonographic appearance of a mass lesion). In some countries, a TUS examination report with imperative instructions for further patient management may cause medicolegal problems if a recommended action is not followed by the clinically responsible physician. In other countries, such instructions are required. Therefore, wording must be adjusted according to national guidelines. Recommended content of a TUS examination report is provided in ► **Table 4** (adapted from Wüstner et al.) [1].

9. TUS quality assurance

The principles for quality assurance described in EFSUMB's professional standards for general aspects in medical ultrasound also apply for quality assurance of TUS examinations [1]. Regular, standardized, audit and critical review of TUS examination reports and archived TUS images and cine-loops is recommended at an institutional/departmental level.

10. Conclusion and future outlook

Despite the rapidly growing evidence to support the use of TUS, many of the practical aspects described above vary considerably from specialty to specialty, country to country, institution to institution, and ultrasound practitioner to ultrasound practitioner. In this manuscript, we have described the standards that EFSUMB considers optimal for all TUS practitioners. It is the authors' hope that this will be an important step in ensuring a more standardized approach to performing TUS, which is of utmost importance for achieving the best quality of TUS at an international level.

Conflict of Interest

Christian B. Laursen: Lecture fees from AstraZeneca, Chiesi Pharma, GlaxoSmithKline Pharma, Boehringer Ingelheim. Christian Jenssen: Lecture fee from Fujifilm, Research support by GE HealthCare, Mindray and Bracco, Support of ultrasound courses and workshops by Fujifilm, GE Healthcare, Siemens Healthineers, Mindray, Samsung, Bracco. Paul Sidhu: Lecture fees from Philips, Bracco, Samsung, Research grants Philips, Samsung, Siemens, Consulting ITREAS. Caroline Ewertsen: Lecture fee from Bracco. Authors with no COI's declared: Gabriele Via, Damien Basille, Rahul Bhatnagar, Lars Konge, Silvia Mongodi, Pia Iben Pietersen, Helmut Prosch, Najib M. Rahman, Mathias Wuestner.

References

- [1] Wustner M, Radzina M, Calliada F et al. Professional Standards in Medical Ultrasound – EFSUMB Position Paper (Long Version) – General Aspects. *Ultraschall in Med* 2022; 43: e36–e48. doi:10.1055/a-1857-4435
- [2] Laursen CB, Via G, Basille D et al. Thoracic Ultrasound – EFSUMB Training Recommendations, a position paper. *Ultraschall in Med* 2025. doi:10.1055/a-2664-6541
- [3] [Anonymous]. Thoracic Ultrasound. European Respiratory Society. 2018. doi:10.1016/j.rmed.2025.108076
- [4] Laursen CB, Clive A, Hallifax R et al. European Respiratory Society Statement on Thoracic Ultrasound. *Eur Respir J* 2020. doi:10.1183/13993003.01519-2020
- [5] Corcoran JP, Psallidas I, Hallifax RJ et al. Ultrasound-guided pneumothorax induction prior to local anaesthetic thoracoscopy. *Thorax* 2015; 70: 906–908. doi:10.1136/thoraxjnl-2014-206676
- [6] Davidsen JR, Bendstrup E, Henriksen DP et al. Lung ultrasound has limited diagnostic value in rare cystic lung diseases: a cross-sectional study. *Eur Clin Respir J* 2017; 4: 1330111. doi:10.1080/20018525.2017.1330111
- [7] Davidsen JR, Laursen CB, Bendstrup E et al. Lung Ultrasound – A Novel Diagnostic Tool To Phenotype Chronic Lung Allograft Dysfunction? *Ultrasound Int Open* 2017; 3: E117–E119. doi:10.1055/s-0043-116489
- [8] Bedawi EO, Talwar A, Hassan M et al. Intercoastal vessel screening prior to pleural interventions by the respiratory physician: a prospective study of real world practice. *Eur Respir J* 2020; 55. doi:10.1183/13993003.02245-2019
- [9] Hussain A, Via G, Melniker L et al. Multi-organ point-of-care ultrasound for COVID-19 (PoCUS4COVID): international expert consensus. *Crit Care* 2020; 24: 702. doi:10.1186/s13054-020-03369-5
- [10] Mei F, Bonifazi M, Rota M et al. Diagnostic Yield and Safety of Image-Guided Pleural Biopsy: A Systematic Review and Meta-Analysis. *Respiration* 2021; 100: 77–87. doi:10.1159/000511626
- [11] Psallidas I, Hassan M, Yousuf A et al. Role of thoracic ultrasonography in pleurodesis pathways for malignant pleural effusions (SIMPLE): an open-label, randomised controlled trial. *Lancet Respir Med* 2022; 10: 139–148. doi:10.1016/S2213-2600(21)00353-2
- [12] Pitsidianakis G, Vassalou EE, Vasarmidi E et al. Performance of Lung Ultrasound for Monitoring Interstitial Lung Disease. *J Ultrasound Med* 2022; 41: 1077–1084. doi:10.1002/jum.15790
- [13] Laursen CB, Pietersen PI, Jacobsen N et al. Lung ultrasound assessment for pneumothorax following transbronchial lung cryobiopsy. *ERJ Open Res* 2021; 7. doi:10.1183/23120541.00045-2021
- [14] Jarman RD, McDermott C, Colclough A et al. EFSUMB Clinical Practice Guidelines for Point-of-Care Ultrasound: Part One (Common Heart and Pulmonary Applications) LONG VERSION. *Ultraschall in Med* 2023; 44: e1–e24. doi:10.1055/a-1882-5615
- [15] Safai Zadeh E, Gorg C, Prosch H et al. The Role of Thoracic Ultrasound for Diagnosis of Diseases of the Chest Wall, the Mediastinum, and the Diaphragm-Narrative Review and Pictorial Essay. *Diagnostics (Basel)* 2023; 13. doi:10.3390/diagnostics13040767
- [16] Ovesen SH, Clausen AH, Kirkegaard H et al. Point-of-Care Lung Ultrasound in Emergency Medicine: A Scoping Review With an Interactive Database. *Chest* 2024. doi:10.1016/j.chest.2024.02.053
- [17] Volpicelli G, Elbarbary M, Blaivas M et al. International evidence-based recommendations for point-of-care lung ultrasound. *Intensive Care Med* 2012; 38: 577–591. doi:10.1007/s00134-012-2513-4
- [18] [Anonymous]. Minimal Training Requirements for the Practice of Medical Ultrasound in Europe. Appendix 11: Thoracic Ultrasound. 2008
- [19] Ozgokce M, Durmaz F, Yavuz A et al. Shear-Wave Elastography in the Characterization of Pleural Effusions. *Ultrasound Q* 2019; 35: 164–168. doi:10.1097/RUQ.0000000000000424
- [20] Petersen JK, Fjaellegaard K, Rasmussen DB et al. Ultrasound in the Diagnosis of Non-Expandable Lung: A Prospective Observational Study of M-Mode, B-Mode, and 2 D-Shear Wave Elastography. *Diagnostics (Basel)* 2024; 14. doi:10.3390/diagnostics14020204
- [21] Rafailidis V, Andronikou S, Mentzel HJ et al. Contrast-enhanced ultrasound of pediatric lungs. *Pediatr Radiol* 2021; 51: 2340–2350. doi:10.1007/s00247-020-04914-8
- [22] Quarato CMI, Cipriani C, Dimitri L et al. Assessing value of contrast-enhanced ultrasound vs. conventional transthoracic ultrasound in improving diagnostic yield of percutaneous needle biopsy of peripheral lung lesions. *Eur Rev Med Pharmacol Sci* 2021; 25: 5781–5789. doi:10.26355/eurrev_202109_26796
- [23] Jacobsen N, Pietersen PI, Nolsoe C et al. Clinical Applications of Contrast-Enhanced Thoracic Ultrasound (CETUS) Compared to Standard Reference Tests: A Systematic Review. *Ultraschall in Med* 2022; 43: 72–81. doi:10.1055/a-1143-3141
- [24] Safai Zadeh E, Gorg C, Prosch H et al. WFUMB Technological Review: How to Perform Contrast-Enhanced Ultrasound of the Lung. *Ultrasound Med Biol* 2022; 48: 598–616. doi:10.1016/j.ultrasmedbio.2021.11.014
- [25] Boccattoda A, Guagnano MT, D'Ardes D et al. The Role of Contrast-Enhanced Ultrasound in the Differential Diagnosis of Malignant and Benign Subpleural Lung Lesions. *J Clin Med* 2024; 13. doi:10.3390/jcm13082302
- [26] Vilmann P, Clementsen PF, Colella S et al. Combined endobronchial and esophageal endosonography for the diagnosis and staging of lung cancer: European Society of Gastrointestinal Endoscopy (ESGE) Guideline, in cooperation with the European Respiratory Society (ERS) and the European Society of Thoracic Surgeons (ESTS). *Endoscopy* 2015; 47: c1. doi:10.1055/s-0034-1392453
- [27] [Anonymous]. Interventional Pulmonology. 2017. doi:10.1183/2312508X.erm7817
- [28] Nadim G, Laursen CB, Pietersen PI et al. Prehospital emergency medical technicians can perform ultrasonography and blood analysis in prehospital evaluation of patients with chronic obstructive pulmonary disease: a feasibility study. *BMC Health Serv Res* 2021; 21: 290. doi:10.1186/s12913-021-06305-7

- [29] Pietersen PI, Mikkelsen S, Lassen AT et al. Quality of focused thoracic ultrasound performed by emergency medical technicians and paramedics in a prehospital setting: a feasibility study. *Scand J Trauma Resusc Emerg Med* 2021; 29: 40. doi:10.1186/s13049-021-00856-8
- [30] Biegler N, McBeth PB, Tevez-Molina MC et al. Just-in-Time Cost-Effective Off-the-Shelf Remote Telementoring of Paramedical Personnel in Bed-side Lung Sonography-A Technical Case Study. *Telemed J E Health* 2012. doi:10.1089/tmj.2012.0038
- [31] Janssen S, Grobusch MP, Heller T. "Remote FASH" tele-sonography – a novel tool to assist diagnosing HIV-associated extrapulmonary tuberculosis in remote areas. *Acta Trop* 2013; 127: 53–55. doi:10.1016/j.actatropica.2013.03.014
- [32] McBeth PB, Crawford I, Blaivas M et al. Simple, almost anywhere, with almost anyone: remote low-cost telementored resuscitative lung ultrasound. *J Trauma* 2011; 71: 1528–1535. doi:10.1097/TA.0-b013e318232cca7
- [33] Wolfram F, Miller D, Demi L et al. Best Practice Recommendations for the Safe use of Lung Ultrasound. *Ultraschall in Med* 2023; 44: 516–519. doi:10.1055/a-1978-5575
- [34] World Federation for Ultrasound in M, Biology Safety C, Abramowicz JS et al. World Federation for Ultrasound in Medicine and Biology Position Statement: How to Perform a Safe Ultrasound Examination and Clean Equipment in the Context of COVID-19. *Ultrasound Med Biol* 2020; 46: 1821–1826. doi:10.1016/j.ultrasmedbio.2020.03.033
- [35] Laursen CB, Davidsen JR, Gleeson F. Technique and protocols. In: Laursen CB, Rahman N, Volpicelli G, ed.; *Thoracic Ultrasound (ERS Monograph)* European Respiratory Society; 2018: 14–30. doi:10.1183/2312508X.10006117
- [36] Laursen CB, Sloth E, Lambrechtsen J et al. Focused sonography of the heart, lungs, and deep veins identifies missed life-threatening conditions in admitted patients with acute respiratory symptoms. *Chest* 2013; 144: 1868–1875. doi:10.1378/chest.13-0882
- [37] Laursen CB, Sloth E, Lassen AT et al. Point-of-care ultrasonography in patients admitted with respiratory symptoms: a single-blind, randomised controlled trial. *Lancet Respir Med* 2014; 2: 638–646. doi:10.1016/s2213-2600(14)70135-3
- [38] Mongodi S, De Luca D, Colombo A et al. Quantitative Lung Ultrasound: Technical Aspects and Clinical Applications. *Anesthesiology* 2021; 134: 949–965. doi:10.1097/ALN.0000000000003757
- [39] Aichhorn L, Habrina L, Werther T et al. Comparison of different types of ultrasound probes for lung ultrasound in neonates-A prospective randomized comparison study. *PLoS One* 2024; 19: e0306472. doi:10.1371/journal.pone.0306472
- [40] Schmickl CN, Menon AA, Dhokarh R et al. Optimizing B-lines on lung ultrasound: an in-vitro to in-vivo pilot study with clinical implications. *J Clin Monit Comput* 2020; 34: 277–284. doi:10.1007/s10877-019-00321-z
- [41] Pivetta E, Baldassa F, Masellis S et al. Sources of Variability in the Detection of B-Lines, Using Lung Ultrasound. *Ultrasound Med Biol* 2018; 44: 1212–1216. doi:10.1016/j.ultrasmedbio.2018.02.018
- [42] Gomond-Le Goff C, Vivalda L, Foligno S et al. Effect of Different Probes and Expertise on the Interpretation Reliability of Point-of-Care Lung Ultrasound. *Chest* 2020; 157: 924–931. doi:10.1016/j.chest.2019.11.013
- [43] Salamonsen MR, Lo AKC, Ng ACT et al. Novel use of pleural ultrasound can identify malignant entrapped lung prior to effusion drainage. *Chest* 2014; 146: 1286–1293. doi:10.1378/chest.13-2876
- [44] Testa A, Soldati G, Giannuzzi R et al. Ultrasound M-mode assessment of diaphragmatic kinetics by anterior transverse scanning in healthy subjects. *Ultrasound Med Biol* 2011; 37: 44–52. doi:10.1016/j.ultrasmedbio.2010.10.004
- [45] Matamis D, Soilemezi E, Tzagourias M et al. Sonographic evaluation of the diaphragm in critically ill patients. Technique and clinical applications. *Intensive Care Med* 2013; 39: 801–810. doi:10.1007/s00134-013-2823-1
- [46] Skaarup SH, Lokke A, Laursen CB. The Area method: a new method for ultrasound assessment of diaphragmatic movement. *Crit Ultrasound J* 2018; 10: 15. doi:10.1186/s13089-018-0092-5
- [47] Prosch H, Strasser G, Sonka C et al. Cervical ultrasound (US) and US-guided lymph node biopsy as a routine procedure for staging of lung cancer. *Ultraschall in Med* 2007; 28: 598–603. doi:10.1055/s-2007-963215
- [48] Kristensen MS, Teoh WH, Graumann O et al. Ultrasonography for clinical decision-making and intervention in airway management: from the mouth to the lungs and pleurae. *Insights Imaging* 2014; 5: 253–279. doi:10.1007/s13244-014-0309-5
- [49] van Overhagen H, Brakel K, Heijenbrok MW et al. Metastases in supraclavicular lymph nodes in lung cancer: assessment with palpation, US, and CT. *Radiology* 2004; 232: 75–80. doi:10.1148/radiol.2321030663
- [50] Koegelenberg CF, Diacon AH, Irusen EM et al. The diagnostic yield and safety of ultrasound-assisted transthoracic biopsy of mediastinal masses. *Respiration* 2011; 81: 134–141. doi:10.1159/000322005
- [51] Dietrich CF, Liesen M, Buhl R et al. Detection of normal mediastinal lymph nodes by ultrasonography. *Acta Radiol* 1997; 38: 965–969. doi:10.1080/02841859709172111