Journal of Advances in Medicine and Medical Research

33(8): 1-12, 2021; Article no.JAMMR.66399
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

The Diagnostic Performance of Chest Ultrasonography in the Up-to-date Workup in Patients with Chest Diseases

Esraa Mohammed El Zaablawy[1*], Mohamed Fouad Sherif[2], Faten Mohammed Salem [2] and Rasha Mahmoud Dawoud [2]

[1]Radiology, Ministry of Health, Egypt.
[2]Radio Diagnosis and Medical Imaging, Faculty of Medicine, Tanta University, Egypt.

Authors' contributions

This work was carried out in collaboration between all authors. Author EMElZ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MFS and FMS managed the analyses of the study. Author RMD managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2021/v33i830879
Editor(s):
(1) Dr. Edward J Pavlik, Univ. Kentucky Medical Center, USA.
Reviewers:
(1) Oinam Gokulchandra Singh, King Saud Bin Abdul-Aziz University for Health Sciences (KSAU-HS), Saudi Arabia.
(2) Mojisola A. Olusola-Bello, Olabisi Onabanjo University Teaching Hospital, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/66399

Original Research Article

Received 25 January 2021
Accepted 30 March 2021
Published 03 April 2021

ABSTRACT

Background: Application of chest radiography for all patients with chest diseases is associated with a significant increase in total costs, exposure to radiation, and overcrowding of the emergency department in case of emergency. Ultrasound has been introduced as an alternative diagnostic tool in this regard. The aim of the work is to determine sensitivity, specificity and diagnostic accuracy of chest ultrasonography as an easy and fast form of imagery for different thoracic conditions.

Results: This prospective study was carried out on sixty patients. The majority of patients presented with lung masses (20%) and pleural effusion (16.7%). Chest US findings showed great concordance or agreement with the chest CT findings. The only lower concordance is noted in the diagnosis of pulmonary nodules or mass, where chest US reported pulmonary nodules or mass in 33.3% of patients compared to 46.7%% by chest CT. US showed a highly comparable diagnostic performance in chest-related pathological entities, compared to chest CT. Chest US had 100%

**Corresponding author: E-mail: Roaaelzaablawy@gmail.com;*

sensitivity in detecting all pathological chest entities except for lung collapse (83.3%) and pulmonary nodules (71.4%). However, chest US was more specific than sensitive. It had 100% specificity in all pathological entities except for lung collapse consolidation. Chest US had 100% diagnostic accuracy in all chest-related pathological entities except for lung collapse consolidation and pulmonary nodules or masses. However, when presenting these findings among male and female patients, Chest US had better overall diagnostic accuracy among female patients than male patients.

Conclusion: US examination of the chest is a noninvasive and promising bedside tool for the examination of respiratory problems patients. Consequently, chest ultrasonography can be adjoined in the up-to-date work-up of the outpatients as an ancillary tool aiding in disease diagnosis.

Keywords: Chest; ultrasonography; work-up; chest disease.

ABBREVIATION

US	:	*Ultrasound*
MDCT	:	*Multi-detector Computed Tomography*
CXR	:	*Chest X-ray*
TP	:	*True positive*
TN	:	*True negative*
FP	:	*False positive*
FN	:	*False negative*
NPV	:	*Negative predictive value*
PPV	:	*Positive predictive value*

1. BACKGROUND

In recent decades, the ultrasound chest test has progressed. Current diagnosis of several pathological conditions , quality and quantitative information is provided by this imaging modality [1]. In modern lung medicine ultrasound has become an essential diagnostic tool for cheap, bedtime accessible and no exposure to radiation [2].

Chest ultrasound has recently given new insights into lung and pleural diseases [3]. In order to assess a wide variety of chest disorders, it has proved valuable, particularly if the pleural cavity is concerned. It can integrate other chest imaging methods and lead a variety of therapeutically and diagnostic procedures. The chest ultrasound is easily and accurately used to identify pleural effusion, pleural thickening, pleural cancers, tumour penetration into the pleura and even chest wall, pleuritis and pneumothorax [2].

The fact that the reflection and reverberation of lung parenchyma's in the ultrasound detection region represents the underlying pathology in the lung diseases has, however, resulted in an increased use of the ultrasound imaging as a standard of care, which has been supported by evidence and experimental scientists [4].

Mobile and portable devices allow lung ultrasound (US) scans to be performed directly at the bedside, thereby avoiding any time losses associated with patient transfers and thereby theoretically enhancing patient comfort. An adjustment to the gain and profundity of a convex abdominal (3.5 MHz) sample can be used. Practitioners can also use a linear HF US (7–16 MHz) or a cardiac sample [5].

Today, the Computed Tomography (CT) chest scan is the gold standard for lung imaging and nearly 100% is sensitive and specific to the diagnosis of pulmonary diseases [6,7]. Its limited availability and the use of ionizing radiation restrict its use, though [8].

The aim of the work is to determine sensitivity, specificity and diagnostic accuracy of chest ultrasonography as an easy and fast form of imagery for different thoracic conditions.

2. METHODS

2.1 Study Design and Population

2.1.1 Study place

Radio-diagnosis and Medical Imaging department, at Tanta University Hospitals.

2.1.2 Study duration

Three years, from November 2016 to November 2019.

2.1.3 Study type

Prospective study.

2.1.4 Data collection

This study included sixty patients all of them underwent chest US firstly, and then post-contrast chest Multi-detector Computed Tomography (MDCT) for further appraisal of the provisional diagnosis made. Their age ranged from 7 years to 76 years old with a mean age of 55.2 years (±16.3).

Inclusion criteria: Patients who were presented with clinical suspicion of chest problem, e.g. (dyspnea, cough, chest pain, hemoptysis).

Exclusion criteria: Patients having contraindications for post contrast chest Multidetector computed tomography MDCT (renal impairment, hepatic failure and history of allergy to iodine contrast) and patients with severely deformed chest cage or subcutaneous emphysema who were unfit for ultrasonography.

2.2 Preparation and Protocol

All patients included in our study underwent chest US firstly, and then post-contrast chest Multi-detector Computed Tomography (MDCT) for further appraisal of the provisional diagnosis made. The accuracy is relative to CT. CT is the gold standard.

All studied Patients were subjected to the following:

1. Full clinical evaluation by history and clinical examination: The patient’s history included personal data and history of any presenting complaint and any relevant history.
2. Kidney function tests including urea and serum creatinine
3. Chest US was carried out on all patients
4. Multi-Detector CT of the chest including pulmonary , mediastinal and bone windows

2.3 The Ultrasound Examination

Chest ultrasound was performed on TOSHIBA APLIO 500 with multiple range convex probe (3:5 MHz) and multiple range linear probe (7: 13 MHz) using both B and M modes.

Clavicle, parasternal and anterior axillary lines and diaphragm defined the anterior surface of each lung, while the posterior surface of the lung was defined by posterior axillary lines and paraverbal lines. On the other hand, the front and back axillary lines defined the lateral surface. The upper and the lower portion of each area were divided.

Patients were scanned in the sitting or the supine positions. Bedridden patients were examined by turning them to the oblique or the lateral decubitus position. The patient raises his or her arms and places the hands at the back of the head to slightly extend the intercostal spaces and rotate the scapula outside. The probe was moved in transverse or longitudinal positions along the intercostal spaces to avoid interference by the bony cage.

A clear water - based gel was added before the treatment on the skin to enable the transducer to easily pass across the skin and to remove air from the skin with the transducer. Scanning during quiet breathing was carried out to enable an examination of the normal movement of the lungs and in suspended breathing, so that lesions could be investigated with grayscale in depth.

Normal lung identification was carried out as the natural lung triggers lung-sliding and "A-lines" (pleural line repeated lines). In addition to the "seafront symbol," this is demonstrated in M-mode (gross nature of the respirophasic movements which underpins the horizontal movement of the thoracic wall and the equivalent of the B-mode lung sliding) and B-lines, which also are considered to be "comet tails."

2.4 The Chest CT Examination

MDCT was performed with a Siemens 77926 Atom Perspective (128 Slice CT scanner). Scans were obtained in the supine position from the apex of the thorax to the lung bases. MDCT scans were evaluated for pulmonary abnormalities.

At first, we explain the examination to the patient. Total immobilization of the patient during the examination is of vital importance.

Patients were placed in the supine position, head first position.

Scanning is planned from the level of the lung apex down to end of both costophrenic angles in a single breath hold.

Contrast administration was performed using power injector (Accutron CT-D automatic CT injector). Nonionic water soluble contrast (Ultravist) was used in all patients using wide bore cannula (18-20 G) inserted in peripheral vein. The injected amount ranged 100-140 ml at rate of 3-3.5 cc/sec.

Use of intravenous contrast material has been shown to improve CT evaluation of indeterminate diagnoses.

For the display of soft tissues, a window level of 40 HU and a window width between 400 and 700 HU were selected; these provide enough contrast between fat and air. A window level between 40 and 300 HU and a window width between 2400 and 3200 HU were selected for imaging of bony structures. A window level between -600 and -1000 HU were selected for imaging of air.

Image reconstruction and manipulation were performed on a workstation (Vitrea). Many post-processing techniques, such as Multiplanner reconstruction (MPR), Maximum intensity Projection (MIP), curved MPR and Volume Rendering Technique (VRT) were done in many cases. However, inspection of the axial source images remains an essential part of the assessment.

The interpretation of the images was done by two expert radiologist who had experience in radiology 18 and 10 years. All cases reviewed blindly and the decision was taken together. Final diagnosis was made based on clinical data and radiological findings for all cases with histopathology reports for some cases.

2.5 Statistical Analysis

Data were entered, manipulated, and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Categorical variables were described using frequency tables (as frequency and %), and quantitative variables were described as mean, standard deviation and range. Chi-square test was used for testing the statistical significance of the associations between categorical variables. However, Fisher's exact test was used when expected frequencies in more 25% of cells had values less than 5 or any cell had a value of zero. P-values less than 0.05 was considered statistically significant. Diagnostic performance was assessed by calculating the sensitivity (%), specificity (%), negative and positive predictive values (NPV and PPV).

3. RESULTS

This study included twenty-six female patients (43.3%) and thirty-four male patients (56.7%). The age of participants ranged from 7 years to 76 years, with a mean age of 55.2 yeas (±16.3). The majority of patients presented with dyspnea (66.7%), chest pain (63.3%), and cough (50.0%). However, other clinical presentations such hemoptysis, fever, or disfiguring chest wall mass were reported by 6.7% for each.

As regard the final diagnoses of patients in this study. 26 cases (43.33%) presented with pulmonary nodules/masses, 26 cases (43.33%) presented with pleural pathologies, 4 cases (6.66%) presented with pneumonic consolidation and 4 cases (6.66%) presented with chest wall masses Table 1.

US findings were compared to CT findings, US showed pneumonic consolidation in 4 cases (6.66%), lung collapse and consolidation in 12 cases (20%). Observations of pulmonary nodules /masses were obtained by US in 20 cases (33.3%), pleural effusion in 20 cases (33.3%), pleural thickening in 8 cases (13.3%), pneumothorax in 4 cases (6.66%) and chest wall masses in 4 cases (6.66%). CT showed pneumonic consolidation in 4 cases (6.66%), lung collapse and consolidation in 12 (20%) cases. Observations of pulmonary nodules /masses in 28 cases (46.6%) , pleural effusion in 18 cases (30%), pleural thickening in 8 cases (13.3%) , pneumothorax in 4 cases (6.66%) and chest wall masses in 4 cases (6.66%). US couldn't determine pulmonary nodules/masses in 8 cases (13.3%), because they were central. Chest US findings showed great concordance or agreement with the chest CT findings. The only lower concordance is noted in the diagnosis of pulmonary nodules or mass, where chest US reported pulmonary nodules or mass in 33.3% of patients compared to 46.7% by chest CT. Table 2. Note that some patients have more than one finding.

Among the tested 60 patients, 4 of them were positive for pneumonic consolidation with both chest US and chest CT (True positive cases), also there are 56 patients who were negative for pneumonic consolidation with both US and CT (True negative cases). Among the 60 patients 12 cases of chest US showed lung collapse and consolidation, 10 of them were positive for the same finding in CT chest (True positive cases) and only 2 cases were positive in US and negative in CT chest (False positive cases). The remaining 48 cases were negative for lung collapse and consolidation, and 46 of them were negative in both US and CT chest (True negative cases) and only two cases were negative in chest US and positive in CT chest (False negative cases). For pulmonary nodules/masses, there was 20 true positive cases and 40 true negative cases. For pleural effusion, there was 18 true positive cases and 42 true negative cases. For pleural thickening, there was 8 true positive cases and 52 true negative cases. For pneumothorax there was 4 true positive cases and 56 true negative cases. For chest wall masses there was 4 true positive cases and 56 true negative cases. Table 3, 4.

Table 1. Distribution of patients according to final diagnoses

Diagnoses		No.	%
Pulmonary nodules/mass	Lung Mass	12	20.0%
	Lung Mass with Extra-thoracic Component	2	3.33%
	Solid & Cystic Lung Mass	4	6.66%
	Central Pulmonary Nodule	4	6.66%
	Pleural-based Nodule	4	6.66%
Chest wall pathology	Chest Wall Mass	4	6.66%
Pneumonic consolidation	Pneumonia	4	6.66%
Pleural pathologies	Pneumothorax	4	6.66%
	Pleural Thickness	4	6.66%
	Pleural Effusion	10	16.7%
	Pleural Effusion with Mass	4	6.66%
	Encysted Effusion	4	6.66%
	Total	60	100.0%

Table 2. Chest US and chest CT findings in 60 patients

Findings	Number of Patients		P value
	US Chest N= 60	CT Chest N=60	
Pneumonic consolidation	4 (6.66%)	4 (6.66%)	1
Lung collapse consolidation	12 (20%)	12 (20%)	1
Pulmonary nodules/mass	20 (33.3%)	28 (46.6%)	0.136
Pleural effusion	18 (3 %)	18 (30 %)	1
Pleural thickening	8 (13.3%)	8 (13.3%)	1
Pneumothorax	4 (6.66%)	4 (6.66%)	1
Chest wall mass	4 (6.66%)	4 (6.66%)	1

Table 3. True positive (TP), False positive (FP), True negative (TN) and false negative (FN) results for each of the cases on US, the Accuracy is relative to CT. CT is the gold standard

Pathological entity	US	CT		TP	FP	TN	FN
		-	+				
Pneumonic consolidatio	-	56	0	4	0	56	0
	+	0	4				
Lung collapse consolidation	-	46	2	10	2	46	2
	+	2	10				
Pulmonary nodules/mass	-	32	8	20	0	32	8
	+	0	20				
Pleural effusion	-	42	0	18	0	42	0
	+	0	18				
Pleural Thickening	-	52	0	8	0	52	0
	+	0	8				
Pneumothorax	-	56	0	4	0	56	0
	+	0	4				
Chest wall mass	-	56	0	4	0	56	0
	+	0	4				

The overall diagnostic accuracy denotes the test ability to correctly identify positive and negative findings (i.e. the proportion of all true positive and true negative findings). Chest US had 100% diagnostic accuracy in all chest-related pathological entities except for lung collapse consolidation and pulmonary nodules or masses. However, when presenting these findings among male and female patients. For different pathological entities the overall diagnostic accuracy of chest US was as the following: 100% for pneumonic consolidation (100% in females and 100% in males), 93.3% for lung collapse consolidation (92.3% in females and 94.1% in males), 93.3 % for pulmonary mass/ nodule (100% in females and 76.6 % in males), 100% for pleural effusion (100% in females and 100% in males), 100% for pneumothorax (100% in females and 100% in males), 100% for pleural thickening (100% in females and 100% in males) and 100% for chest wall mass (100% in females and 100% in males). Table 5.

4. DISCUSSION

Imaging assumes a critical role in conjunction with clinical information for the evaluation and management of patients with chest disease [9]. To date, radiography and CT are the imaging modalities utilized for detection and follow up of thoracic diseases. The advantages of low-cost, bedside availability and no radiation exposure have made lung ultrasound an essential diagnostic tool in modern pulmonary medicine [3].

Chest ultrasonography (US) is given more consideration in critical care medicine [10]. The part of Transthoracic Sonography (TS) in the chest was generally been constrained to the assessment of pleural effusion and as a guide for aspiration. TS has turned into an undeniably profitable demonstrative apparatus in different chest diseases. Its effect on the diagnosis and management has been established in several studies, particularly in emergency and critical care settings by utilizing TS, a few conditions might be quickly diagnosed (e.g. pneumonia, pulmonary embolism, pleural, and in addition pericardial effusion, pneumothorax, and atelectasis), or even might be suspected (e.g. diffuse parenchymal lung infection) or may act as a guide for the following diagnostic or therapeutic options [e.g. computed tomography (CT), bronchoscopy, or thoracentesis] [11]. Rather than CT, chest US is non-invasive and does not utilize radiation and contrast materials. At long last, portable US permits patient assessment at bed side and can be repeated when needed without significant side effects [11].

Table 4. True positive (TP), False positive (FP), True negative (TN) and false negative (FN) results in US chest findings in 60 patients

Pathological entity	US		TP	FP	TN	FN
	+	-				
Pneumonic consolidation	4	56	4	0	56	0
Lung collapse consolidation	12	48	10	2	46	2
Pulmonary nodules/mass	20	40	20	0	32	8
Pleural effusion	18	42	18	0	42	0
Pleural Thickening	8	52	8	0	52	0
Pneumothorax	4	56	4	0	56	0
Chest wall mass	4	56	4	0	56	0

Table 5. Overall diagnostic accuracy of chest US considering patients' sex

Pathological entity	Diagnostic accuracy			
	Female (n=26)	Male (n=34)	P value	Total
Pneumonic consolidation	100%	100	1	100%
Lung collapse consolidation	92.3%	94.1%	0.781	93.3%
Pulmonary nodules/mass	100%	76.5%	0.008*	93.3%
Pleural effusion	100%	100%	1	100%
Pneumothorax	100%	100%	1	100%
Pleural Thickening	100%	100%	1	100%
Chest wall mass	100%	100%	1	100%

** significant as P value <0.05*

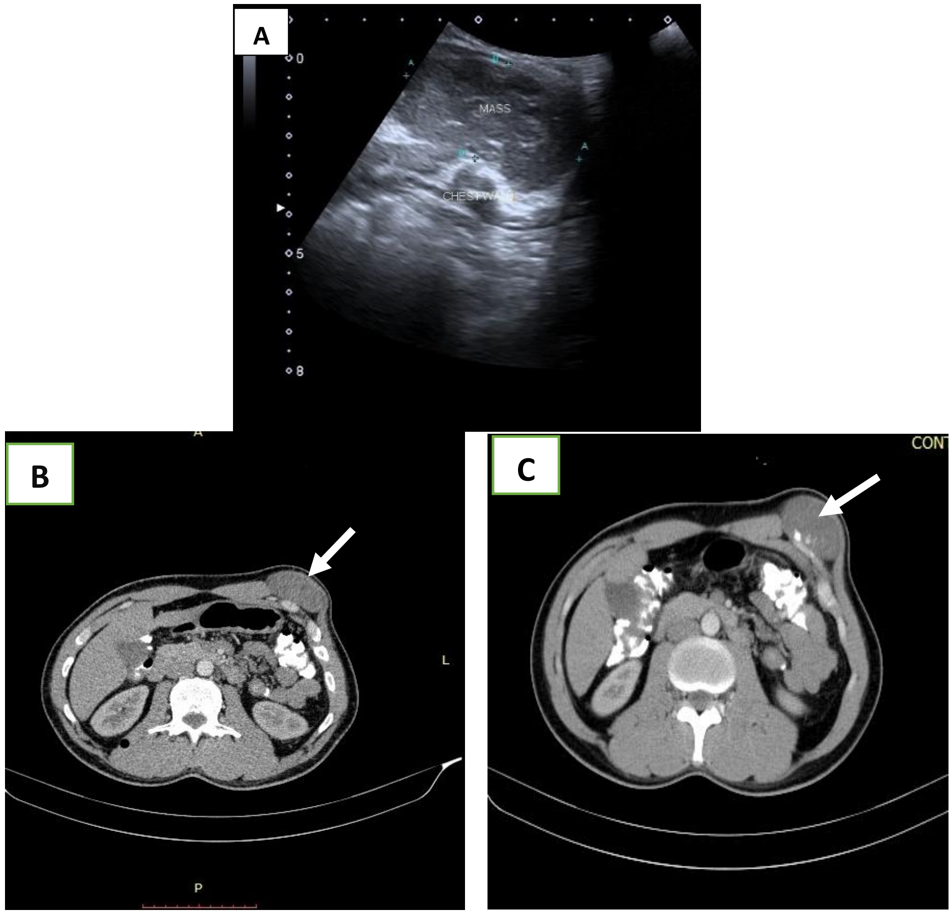


Fig. 1. A 35 years old male patient, complained of disfiguring mass at the lower chest wall. A) Ultrasound examination of the chest showing heterogeneous solid mass inseparable from the lower ribs with foci of calcifications seen inside it, the mass measuring (5 x2.5 cm) B&C) Contrast CT examination showing solid soft tissue density (mass) seen at left antro lateral chest wall measuring (59x38x50mm) with foci of calcification (arrow). The mass elevated left lower chest wall muscles and inseparable from the lower ribs with no intra thoracic component and clear surrounding fat planes. Final diagnosis: **Left lower chest wall soft tissue mass with calcification, condrosarcoma is proven by histopathological examination**

In this study, we evaluated chest US of different pathological pulmonary and pleural entities and the accuracy is relative to the CT.

The involved pulmonary entities included pneumonic consolidation, lung collapse consolidation and pulmonary masses/ nodules. The involved pleural entities included pleural effusion, pleural thickening and pneumothorax. As well as chest wall masses.

In the current study, identification of normal lung was made by visualization of lung sliding and A-lines. These are in addition to B-lines and the seashore sign on M-mode (the equivalent of lung sliding) Fig. 6.

Alternatively, we identified pneumonic consolidation as we were attentive to the patient's clinical history and by using the parenchymal and pleural criteria with a corresponding sensitivity of 100%.

This is in agreement with Refaat and Abdurrahman [12] who identified pneumonic consolidation based on diagnosing pneumonia by visualizing lung consolidation with sonographic air bronchogram with a corresponding sensitivity of 100%. Additionally, detection of pneumonic consolidation by chest US in our study was strongly correlated with its presence on chest CT as shown in Fig. 5.

In identifying Lung collapse consolidation, chest US had a sensitivity, specificity and diagnostic accuracy of 83.3%, 95.8% and 93.3% respectively. Also, chest US in this study failed to diagnose only four patients as the accuracy is relative to the CT.

In identifying pulmonary masses/nodules, chest US had a sensitivity and specificity of 71.4%, 100% respectively. Also, chest US in this study failed to diagnose four patients in comparison to chest CT and successively diagnosed the remaining patients . This occurred because the mass may be central or the nodule is so small. Chest US enables one to visualize even small peripheral metastatic lesions , while CT is the most accurate imaging modality for detecting nodules over the entire lung [13]. This comes in comparison with Negm et al. [14] who have diagnosed them with corresponding sensitivity and specificity of 100% and 100% respectively.

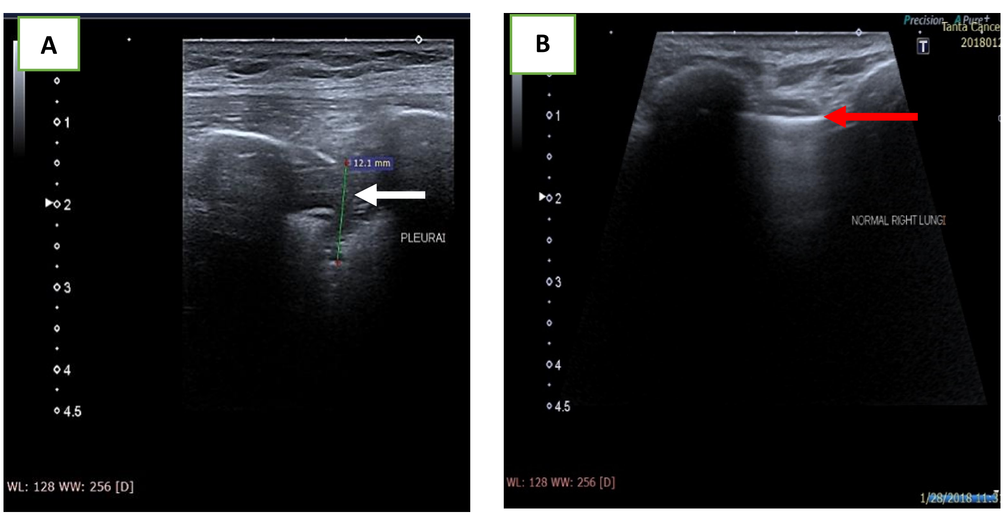
We found peripheral lung masses well by chest US through detection of absent echogenic line of the visceral pleura where the tumor abuts the pleura with posterior acoustic enhancement and typically absent air bronchogram. As shown in Fig.4.

Soni, Nilam et al. [15] found that pleural US in the critically ill patients allows early and frequent assessment as well as accurate characterization of pleural disease than standard CXR combined with physical examination.

In our study, chest US had a sensitivity and specificity of 100% for detection of pleural effusion in proportion to sensitivity of 100% and specificity of 87.7% obtained by other researchers [16].

It is well known that pneumothorax is a frequent diagnosis in the ICU. Its bedside diagnosis is extremely important especially in ICU patients. Chest CT has become the gold standard for this purpose in spite of having inherent problems of time lag, transportation and radiation exposure [17]. In this study, chest US has been successfully used for the identification of pneumothorax in a variety of patients Fig. 3. Thus, a sensitivity of 100% and a specificity of 100% were obtained. This is comparable to a sensitivity of 88.9% and a specificity of 100% in the study performed by Danish et al. [16].

Regarding patients with chest wall mass, chest US successfully diagnosed all patients as US can recognize chest wall more easily by identifying the site, boundaries and consistency of the mass. Similarly, chest US diagnosed all patients with pleural thickening as it is well known that US can readily distinguish between pleural fluid and thickening [2]. In addition, the entry of medical thoracoscopy into the hemithorax can be avoided with the use of US in a case suspicious for mesothelioma to evade tumor seeding [2].



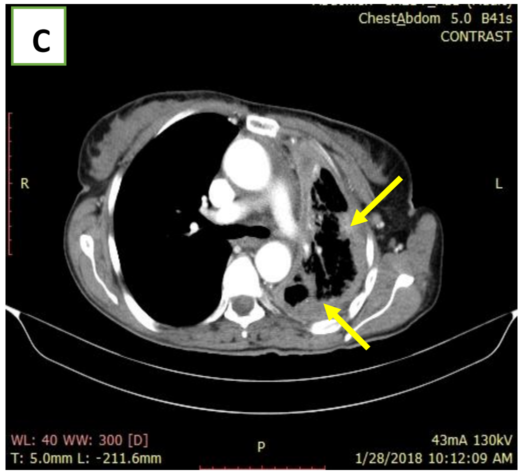


Fig. 2. A 55 years old female patient, was complained of dyspnea and chest pain, diagnosed as metastases of unknown origin (.A&B) Ultrasound examination of the chest showing hypoechioc boarding of the pleural line (Arrow) at the upper left pleura reaching 12mm at the left mid axillary line Fig A(white arrow), with normal pleural thickness (2mm) seen at the right lung at Fig B (red arrow) (C): Post contrast CT of the chest, axial plane, mediastinal window showed decrease compliance of left lung associated with diffuse pleural thickening included the fissural pleura with areas of nodulations (yellow arrows), deformity of the left side of the chest wall, no infiltration of the chest wall. Final diagnosis: Left sided irregular nodular pleural thickening, mesothelioma proven by histopathology

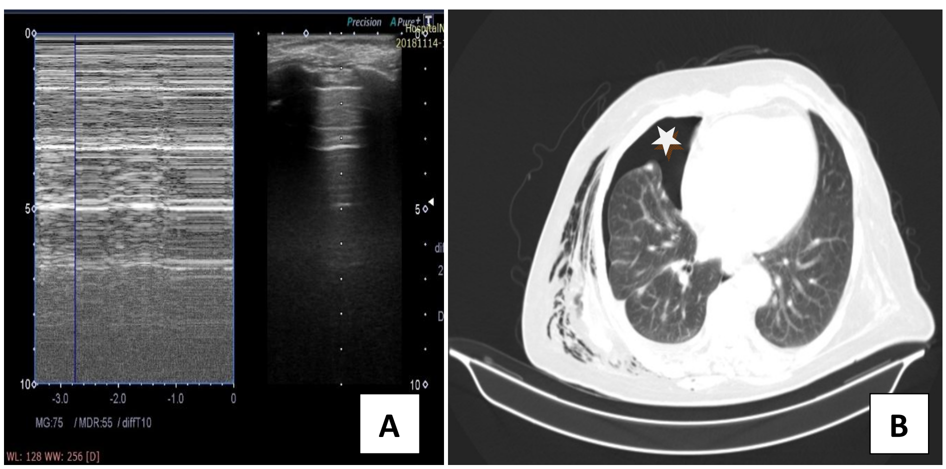


Fig. 3. A 70 years old female patient, that was a known case of metastatizing breast cancer, her complain was severe dyspnea and chest pain following chest tube insertion for pleural effusion. (A) Chest US B mode showed absence of lung sliding, M mode showing barcode sign that's specific for pneumothorax, no sliding, and no seashore sign. Fig (B): Post contrast CT, lung window axial view, showed right side mild pneumothorax (Star) with decrease left lung volume. Surgical emphysema is also noted. Diagnosis: Right side pneumothorax and surgical emphysema

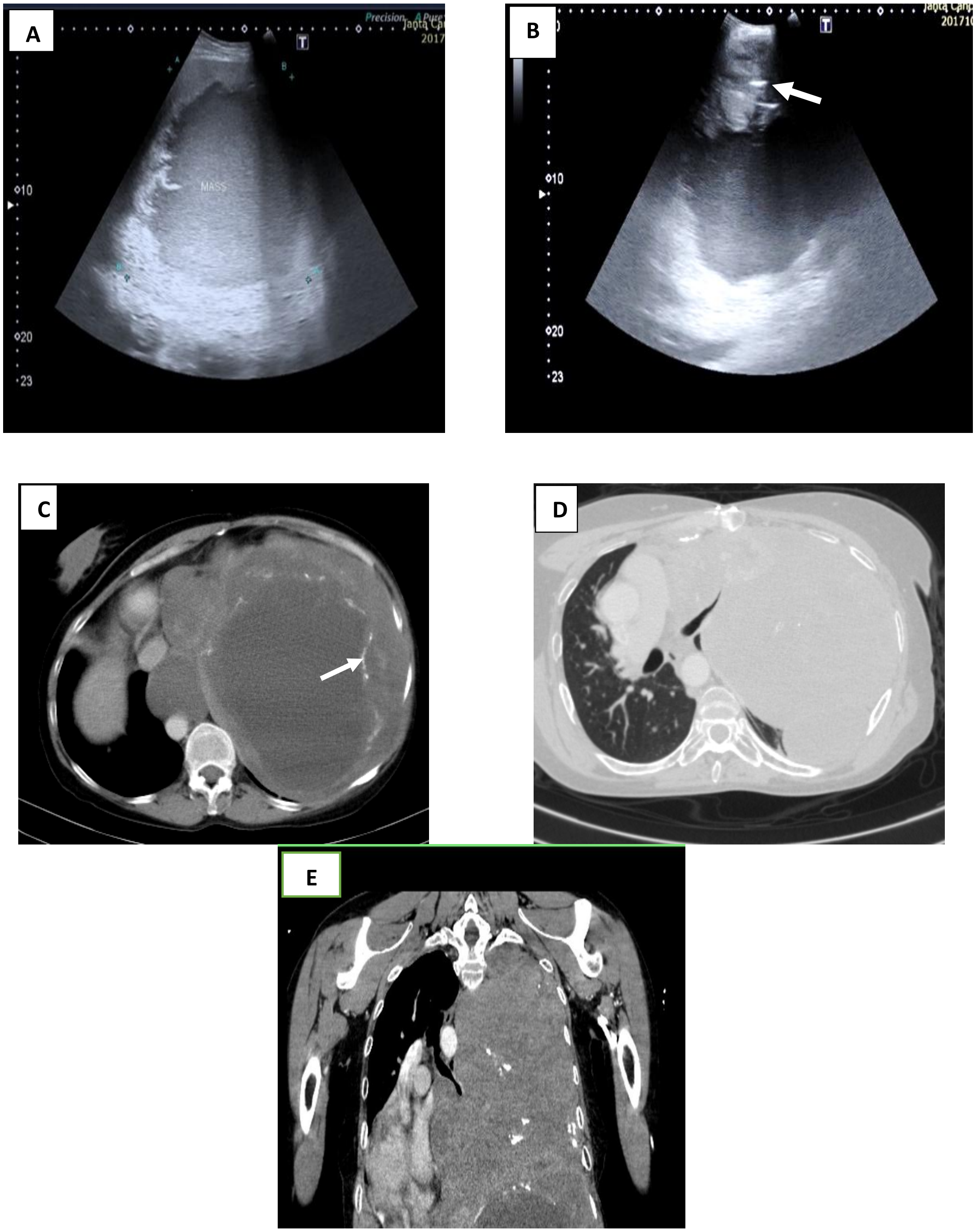


Fig. 4. A 38 years old female patient, complaining of severe dyspnea, chest pain and cough, with history of breast cancer. (A & B) Chest US images: Large heterogenous mass with mixed solid and cystic component and calcifications (arrow). It was seen occupying the whole left lung with no sliding, it measures (19x18 cm) (C & D) Post contrast CT axial view, mediastinal and lung windows showing: Huge heterogeneously enhanced mass occupying nearly the whole left lung Fig E (coronal plane), with mixed solid and cystic component and calcifications inside, invading the left main bronchus measuring 19 x12 cm, shifting the mediastinum to the contralateral side

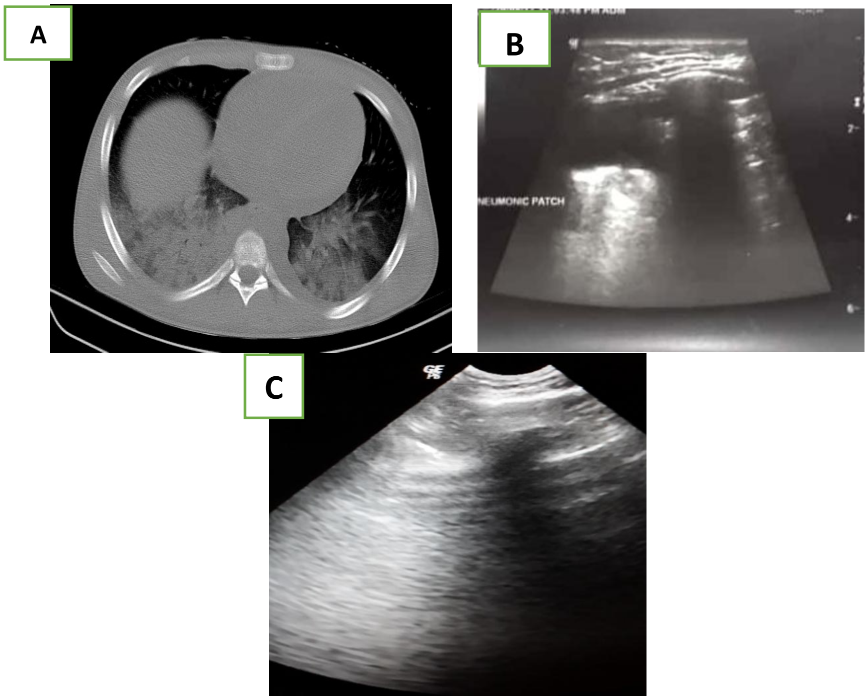


Fig. 5. A 17 years old male patient, complained with fever, tachypnea and dyspnea (A) Post contrast CT lung window axial cuts revealed: Area of increased pulmonary attenuation with air bronchogram seen in basal segment of both lower lobes.(B and C) Chest US images showed bilateral basal increase lung echogenicity . Diagnosis: Bilateral basal posterior consolidation with air bronchogram (pneumonic consolidation)

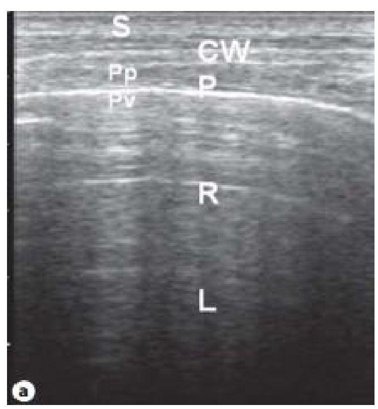


Fig. 6. The typical appearance of a normal chest on US (transverse image through the intercostal space with high frequency probe). The chest wall is visualized as multiple layers of echogenicity representing muscles and fascia. The visceral and parietal pleura appear as echogenic bright lines that slide during respiration. Reverberation artefacts beneath the pleural lines imply an underlying air-filled lung. S= Skin; CW= chest wall; P=pleura; Pp= parietal pleura; Pv =visceral pleura; L= lung; R=reverberation artifact [12]

5. CONCLUSION

US examination of the chest is a noninvasive and promising bedside tool for the examination of respiratory problems patients. Consequently, chest ultrasonography can be included in the work-up of the outpatients as an ancillary tool aiding in disease diagnosis.

CONSENT AND ETHICAL APPROVAL

Ethics committee approved and informed consent were obtained for all patients or their guardian's .Privacy and confidentiality of all patients data were guaranteed, all data provision were monitored and used for security purpose only.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Francisco MJN, Rahal AJ, Vieira FA, et al. Advances in lung ultrasound. Einstein Sao Paulo. 2016;14:443-8.
2. Tsai TH, Yang PC. Ultrasound in the diagnosis and management of pleural disease. Curr Opin Pulm Med. 2003;9:282-90.
3. Vignon P, Repessé X, Vieillard-Baron A, et al. Critical care ultrasonography in acute respiratory failure. Crit Care. 2016;20:228.
4. Wang G, Ji X, Xu Y, et al. Lung ultrasound: a promising tool to monitor ventilator-associated pneumonia in critically ill patients. Critical Care. 2016;20:320.
5. Bourcier JE, Braga S&Garnier D. Lung Ultrasound Will Soon Replace Chest Radiography in the Diagnosis of Acute Community-Acquired Pneumonia. Curr Infect Dis Rep. 2016;18:43.
6. Claessens YE, Debray MP, Tubach F, et al. Early Chest Computed Tomography Scan to Assist Diagnosis and Guide Treatment Decision for Suspected Community-acquired Pneumonia. Am J Respir Crit Care Med. 2015;192:974-82.
7. Haga T, Fukuoka M, Morita M, et al. Computed Tomography for the Diagnosis and Evaluation of the Severity of Community-acquired Pneumonia in the Elderly. Intern Med. 2016;55:437-41.
8. Brenner DJ & Hall EJ. Computed tomography—an increasing source of radiation exposure. New England Journal of Medicine. 2007;357:2277-84.
9. Matulewicz L & Slosarek K. Computer assisted radiology-26th international congress and exhibition. Int J CARS. 2012;7:S307-S65.
10. Havelock T, Teoh R, Laws D, et al. Pleural procedures and thoracic ultrasound: British Thoracic Society Pleural Disease Guideline. Thorax. 2010;65;Suppl 2;ii:61-76.
11. Khalil MM, ELMaraghy AA, Yousef YR. Could chest ultrasonography replace routine chest X-rays in mechanically ventilated patients? Egyptian Journal of Chest Diseases and Tuberculosis. 2015;64:857-63.
12. Refaat R, Abdurrahman LA. The diagnostic performance of chest ultrasonography in the up-to-date work-up of the critical care setting. The Egyptian Journal of Radiology and Nuclear Medicine. 2013;44:779-89
13. Bolliger C, Herth F, Mayo P, et al. Clinical Chest Ultrasound From the ICU to the Bronchoscopy Suite. 2009;37(3):22-23. .
14. Negm MF, Kamel MH, Mohammad OI, et al . The value of chest ultrasonography applications in the respiratory ICU. Egyptian Journal of Bronchology. 2019;13:323.
15. Soni N, Franco R, Velez M, et al. Ultrasound in the diagnosis and management of pleural effusions. Journal of hospital medicine. 2015;10(12):811-816.
16. DANISH, Mohammad, et al. Diagnostic performance of 6-point lung ultrasound in ICU patients: a comparison with chest X-ray and CT thorax. Turkish journal of anaesthesiology and reanimation. 2019;47(4):307-317.
17. Salah H. Diagnostic impact of integrating ultrasonography into routine practice in respiratory intensive care units. Egyptian Journal of Bronchology. 2014;8:66.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/66399