DIAGNOSTIC ACCURACY OF ULTRASONOGRAPHY IN DETECTION OF LUNG CONSOLIDATION TAKING COMPUTED TOMOGRAPHY AS GOLD STANDARD

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Abstract:
Introduction: Lung consolidation is the area of fluid-filled lung tissue and can occurs due to cancer, pneumonia and pulmonary hemorrhage. Uncomplicated cases of consolidation due to pneumonia have a good prognosis and can be properly diagnosed using Lungs ultrasound (LUS) and chest radiography (CXR). LUS has the advantage of a bedside technique and does not pose a radiation hazard.
Aim: To assess the diagnostic accuracy of chest ultrasound (LUS) in detecting lung consolidation by adopting computed tomography (CT) as the gold standard.
Material and methods: This is a cross-sectional study conducted at CMH Lahore between January 16, 2017 and January 15, 2018. LUS was done in patients who met the criteria of inclusion. Later, patients were planned for CT by a senior IT technician and interpreted by one senior radiologist. The results are recorded and compared.
Results: The average age of patients was 42.34 ± 15.98. The LUS diagnostic accuracy was 98.26% with sensitivity 97.37% & specificity 97.75% respectively taking CT scan as gold standard.
Conclusion: LUS is a useful tool for detecting lung consolidation, has high sensitivity, specificity and diagnostic accuracy and can replace chest radiographs.
Keywords: CXR, ultrasound, computed tomography, lung consolidation

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INTRODUCTION:

Lung consolidation is the process of filling the alveoli, which contains exudative fluid that replaces normal alveolar or pulmonary parenchymal air. Due to the filling of these alveoli, there is more attenuation in the pulmonary parenchyma filled with fluid that hinders the edges of the airways and blood vessels around it. This leads to a condition marked by induration of the normally ventilated lung (usually swelling or hardening of soft tissues). (one) Wesley H. S et al. The use of computed tomography (CT) and chest radiography (CXR) to detect pulmonary consolidation was evaluated. In recent years, interest in lung ultrasound (LUS) for use in the diagnosis of pneumothorax, pleural effusion, pulmonary embolism, pneumonia and pulmonary contusions has increased. (2,3)

Chest computed tomography (CT) is considered the gold standard of imaging in the diagnosis of pulmonary consolidation, but its routine use in the diagnosis of consolidation is limited to exposure to high radiation, which is associated with high costs. and usability.

In clinical practice, the consolidation diagnosis is based on the results of clinical trials and is supported by the visualization of typical turbidity in radiography of chest and computed tomography. (3.4)

Confidence in diagnosing lung X-ray of the chest can cause serious misdiagnosis. LUS is a very sensitive bedside diagnostic instrument for diagnosing various lung diseases, including pneumonia (5). LUS by the bed is a dynamic, reliable, non-invasive and fast technique and can be of great worth in diagnosing lung injury in patients with blunt trauma to chest. (6.7)

One study found that LUS was viable in all patients, i.e., sensitivity was 82.8% and specificity was 95.5%, which was higher than the sensitivity of the chest radiograph, and specificity was 90%. LUS is a reliable diagnostic alternative to radiography of chest for the initial diagnosis of lung consolidation in patients with breathing problems. (8)

The aim of this study is to determine the diagnostic accuracy of LUS in determining lung consolidation by using computed tomography as the gold standard. Consolidation is a fairly common condition found in various diseases that affect mortality and morbidity. Chest radiography has traditionally been used for evaluation, but its effectiveness is low.

LUS, an easily accessible, non-invasive, non-invasive bedside technique that can support chest radiographs currently used in several soft tissue screening procedures. However, there is no local evidence in the literature that could help us replace CXR with LUS in the local population.

OBJECTIVE: To assess the diagnostic accuracy of chest ultrasound (LUS) in determining lung consolidation that accept CT as the gold standard

Operational Definition:

Lung Consolidation:
On LUS, it was labeled as positive if there was occurrence of numerous B-lines rising from the pleural line, confluent consolidations (''hepatization''), C-lines, or disruption of parenchyma with local pleural effusion.

MATERIALS AND METHODS:

Study design:
Cross sectional study
Setting:
Department of Radiology, Combined Military hospital, Lahore
Sample size:
It is estimated as 400 cases using 95%(9) with an expected sensitivity as 82%(9) with 6% margin of error, sensitivity 95%(9) with 4% margin of error taking expected percentages of consideration of lung in79%(2) of patients.
Sampling technique:
Non probability consecutive sampling
Selection criteria

Inclusion criteria
Patients from 16 to 70 years of age with FEV1 / FVC <70%> 2 weeks of coughing, wheezing, sputum
Exclusion criteria
• Patients with recurrent problems after surgery (in the history of the disease)
Patients with chronic respiratory symptoms and / or lung cancer.
Patients with pregnancy and morbid obesity (BMI> 35 kg / m2)
Patients with pneumothorax, multiple rib fractures, surgical emphysema, open chest wounds and aspiration (in a clinical trial)

Data collection procedure:
400 patients who met the selection criteria referred to CMH Lahore or CMH Pulmonology, Radiology Department of the Medical Faculty of Lahore. Patient's consent obtained. The researcher applied LUS to patients. It was observed that patients had LUS as a positive or negative result (according to the operational definition). Later, patients underwent a CT scan by a senior CT technician and was

interpreted by one of the best radiologists with at least 4 years of radiology experience. Positive or negative CT scan was confirmed in patients.

Data Analysis:
Using SPSS version 22; collected data were analyzed and entered. Tables 2x2 were created to calculate specificity, sensitivity, NPV, PPV and LUS diagnostic accuracy, which adopts CT as the gold standard.

RESULTS:
A total of 400 cases were included in the study. The average age of patients is 42.34 ± 15.98 years, and their age is 16 and 70 years, respectively. Table 1
In our study, 201 (50.25%) patients were men and 199 (49.75%) were women. The ratio of patients to men and women was 1.01: 1.

LUS in 400 patients diagnosed positive lung consolidation in 175 (43.75%) and negative lung consolidation in 225 (56.25%). Picture 1

Computed tomography of 400 patients showed positive lung consolidation in 172 (43.0%) patients and negative lung consolidation in 228 (57.0%) patients. Picture 2

In this study, computed tomography was adopted as the gold standard, and the sensitivity, diagnostic accuracy, PPV, NPV and LUS were 98.26%, 97.37%, 96.57%, 98.67% and 97.75%, respectively. Table 2

Table 1 Descriptive statistics of age (years):

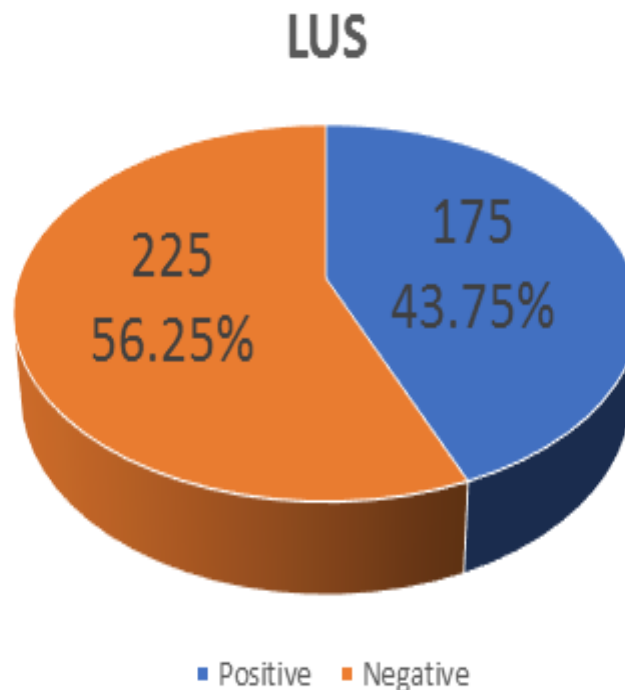| Age (years)	N	400
	Mean	42.34
	SD	15.98
	Minimum	16
	Maximum	70

Fig 1: frequency distribution of LUS
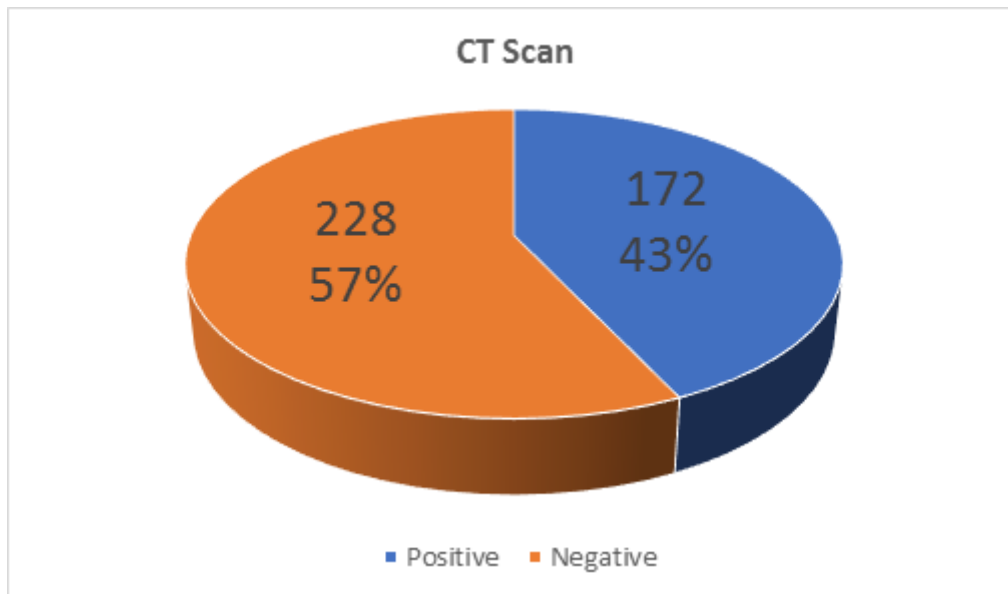
Figure *2*. Frequency distribution of CT scan

Table *2* Comparison of LUS with CT scan

		CT scan		Total
		Positive	**Negative**	
LUS	**Positive**	169	6	**175**
	Negative	3	222	**225**
Total		**172**	**228**	**400**

Sensitivity	**98.26%**
Specificity	**97.37%**
PPV	**96.57%**
NPV	**98.67%**
Diagnostic Accuracy	**97.75%**

DISCUSSION:

This current cross-sectional study was conducted at the radiology department of the combined Lahore military hospital to assess the diagnostic accuracy of CXR and LUS in detecting lung consolidation using CT as the gold standard.

Community-acquired pneumonia is an important health issue globally, unable to prompt daignosis and distribution of treatment result in significant mortality and morbidity. (10) International guidelines commend the usage of CXR as a monotonous assessment of a patient assumed of having pneumonia to detect lung consolidation, but CXR has proved to be insensitive to relatively low accuracy. (11.12) In recent years, LUS has increased interest in the diagnosis of pleural effusion, pneumothorax and lung consolidation in pneumonia, pulmonary embolism and pulmonary injuries. (13,14,15,16)

In our study, CT scan was used as the gold standard, and sensitivity, specificity, PPV, NPV and diagnostic diagnosis of LUS were 98.26%, 97.37%, 96.57%, 98.67% and 97.75%.

One study found that LUS was viable in all patients, i.e., sensitivity was 82.8% and specificity was 95.5%, which was higher than the sensitivity of the chest radiograph, and specificity was 90%. LUS is a reliable diagnostic alternative to CXR for the initial diagnosis of lung consolidation in patients with respiratory problems. (17)

In another study, the sensitivity, specificity, PPV and NPV LUS were 85.2%, 88%, 86.7% and 86.8%, while CXR was 60.7%, 88.1%, 82.2% and 71 1%. (18)

Khaled Fawzy Alkhayat et al. (19) showed that chest ultrasound exhibited important diagnostic value in consolidation because it revealed symptoms of consolidation in forty six patients (74.2%) (p value 0.01).

Research conducted by Xionga Ye et al. (2) has shown that LUS can help diagnose pneumonia acquired in an adult community. By using computed tomography of the chest as a reference, diagnostic accuracy of LUS is better than CR in adult patients with community-acquired pneumonia.

Another study by Francesca Reali et al. (20) performed ultrasound and RXC in all patients. While ultrasound had 94% sensitivity and 96% specificity, CXR showed 82% sensitivity and 94% specificity.

Mark Hew et al. Study (7) found that ultrasound sensitivity ranged from 0.91 (95% CI 0.81 to 0.97) to 1.00 (95% CI 0.95 to 1.00). The specificity ranged from 0.78 (95% CI 0.52 to 0.94) to 1.00 (0.99 to 1.00). In two studies, chest radiography was less sensitive than ultrasound, but there were not enough patients to compare specificity.
Two meta-analyzes of Hu and his friends and Chavez were published. (9.21)

Two studies involving only ventilated patients (22.23) evaluated both ultrasound and chest radiography in the same patient population; The best study design to compare evidence. (24) In both studies, ultrasound sensitivity was significantly higher than chest radiography; 0.24 higher (95% CI 0.15 to 0.34, p <0.0001)
LUS performance is probably very good for detecting superficial pneumonia, but still poor for detecting deep follicular lesions. (25)

CONCLUSION:
According to the results of our study, LUS is a useful tool to consolidate lung detection, has high sensitivity, specificity and diagnostic sensitivity values using CT as the gold standard.

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