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ORIGINAL ARTICLE

# Value of chest ultrasound in diagnosis of community acquired pneumonia

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**KEYWORDS**

Pneumonia;
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**Abstract** Detection of a technique used for diagnosis of Community Acquired Pneumonia by chest ultrasound compared to chest radiograph.

*Study:* Sixty two patients presented with clinically diagnosed pneumonia (acute presentation of fever, cough, purulent expectoration and typical auscultation as rales and bronchial breath sound), patients with chronic chest and cardiac diseases are excluded from the study. Chest ultrasound and chest X-ray were done for all patients.

*Results:* Chest ultrasound showed a significant diagnostic value of consolidation, as it showed signs of consolidation in 46 patients (74.2%) (*P* value 0.01), while Chest X-ray showed signs of consolidation in 32 patients (51.6%) (*P* value more than 0.05).

*Conclusion:* Performance of chest ultrasound for the detection of pneumonia is excellent and superior to chest X-ray considering rapid access to bedside ultrasound and the excellent performance of this simple test.

*Clinical importance:* This study supports the routine use of chest ultrasound for the detection of community acquired pneumonia especially in cases in which chest X-ray is contraindicated or inaccessible.



## Introduction

Community acquired pneumonia (CAP) is the most common disease recorded worldwide. Despite that pneumonia can be simply diagnosed by physical examination, history taking, and specific auscultatory findings, diagnosis has recently become highly dependent on imaging. In an appropriate clinical setting, diagnosis of pneumonia is established in the case of a new infiltrate on a chest radiograph [7]. However, chest radiography is of relatively low accuracy [1]. The accuracy of chest radiography (CXR), which remains the daily reference for lung imaging and a cornerstone for the diagnosis of pneumonia according to the American Thoracic Society criteria, is 65% when compared with CT scan [17]. Additionally, common chest radiography is associated with considerable practical delays related to processing [1]. Because of the methodological limitation of a chest radiograph, CT imaging is regarded as the gold standard allowing for the diagnosis of pneumonia earlier and with a higher sensitivity and specificity [7]. However, CT scan may not always be available and is charged with a high radiation dose and high cost that precludes its use in the rou-

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tine diagnostic process of patients with suspected pneumonia [2,4]. During the last 20 years, ultrasound has been shown to be highly effective in evaluating a range of pathologic pulmonary conditions [13]. One of the most widely practiced applications is the evaluation of pneumonia with ultrasound. Point-of-care ultrasound imaging, performed at the patient's bedside, decreases the delays of chest radiography in the diagnosis of pneumonia [1,5].

The objective of this study was to determine the accuracy of chest US in diagnosing CAP compared with chest radiography.

## Patients and methods

The present study was carried out on 62 patients (28 males and 34 females), their age ranged from 25 to 80 years with mean age of 57.74 years, during the period from february 2013 to february 2014.

The following were done for all patients:

(A) Careful history taking including cough, purulent expectoration, dyspnea, hemoptysis and fever $>38.0$ °C. Patient's history of co morbidity and risk factors was documented.
(B) Clinical examination including:
- Vital signs: heart rate, systemic blood pressure, temperature and respiratory rate.
- Systematic examination: to exclude other coexisting diseases.
- Chest examination: auscultation as rales and bronchial breath sound.

(C) Chest X-ray PA and lateral views.

All patients underwent PA and lateral chest radiography on day 0 and if possible between days 7 and 15.

(D) Chest ultrasound.

Chest US was performed within 24 h after the chest radiograph. Sonography was assessed for the location, shape, size and echogenicity of consolidation as well as necrotic areas, positive air bronchogram, fluid bronchogram and pleural effusion if present.

### *Chest ultrasound technique*

Chest US was done by US unit (Toshiba-Xario) using a 3.5–5-MHz convex probe which allows visualization and quick survey of the pleura and lungs. A high-resolution 7.5–10-MHz linear probe was used to provide detailed depiction of any pleural or peripheral lung abnormality. In the adult patient, the field depth is typically set at 16 to 18 cm.

Each hemithorax was divided into five areas: two anterior, two lateral, one posterior, for a total of 10 areas bilaterally. The anterior chest wall was marked off from the parasternal line to the anterior axillary line. This zone was split into an upper region (from the collar bone to the second–third intercostal space) and a lower region (from the third intercostal space to the diaphragm). The lateral area (anterior to posterior axillary line) was split into upper and lower halves. Finally, the posterior area was identified from the posterior axillary line to the paravertebral line [5].

The ultrasound transducer is moved until a rib interspace is located. The probe is then panned horizontally and vertically to the extent possible to allow the broadest sweep through the area being imaged [1]. Raising the arm above the patient's head increases the rib space distance and facilitates scanning. Before performing the US examination, the patient's chest radiograph was reviewed to localize the area of interest. Scanning was performed during quiet respiration, to allow for assessment of normal lung movement, and in suspended respiration, when a lesion can be examined in detail. The echogenicity of a lesion was compared with that of the liver and characterized as hypoechoic, isoechoic, or hyperechoic [9].

### *US pattern in consolidated lung*

The key to ultrasound visualization of pneumonia in the lungs is relative loss of aeration of a portion of the lung and a concomitant increase in the fluid content, which is seen in lung consolidation. Once this consolidation reaches the pleura, it can be seen with ultrasound. Although some very early pneumonias are so localized as to not about the lung pleura, most make contact at some point and can thus be imaged with ultrasound [12]. In general, the size of the pneumonia appears smaller at US than on radiographs. This is because the periphery of the pneumonia is more air-filled, which results in more artifacts, thus limiting complete visualization of the extent of consolidation [6,9].

The consolidated lung is similar in echogenicity to the liver and spleen. As the disease progresses, the echogenicity increases and becomes more heterogeneous [9]. Within the consolidation, multiple bright dot-like and branching linear structures are found which represent air in the bronchi and scattered residual air in alveoli. This appearance is termed as *sonographic air bronchogram* [8]. Consolidations may contain dynamic air bronchograms (branching echogenic structures showing centrifugal movement with breathing) [11]. If the bronchial tree is filled with fluid rather than air, a branching pattern of anechoic or hypoechoic tubular structures is seen, an appearance termed as *sonographic fluid or mucus bronchogram*. When pneumonia is complicated by lung abscess, it is identified at US as a hypoechoic lesion with a well-defined or irregular wall and anechoic center sometimes with internal ech-

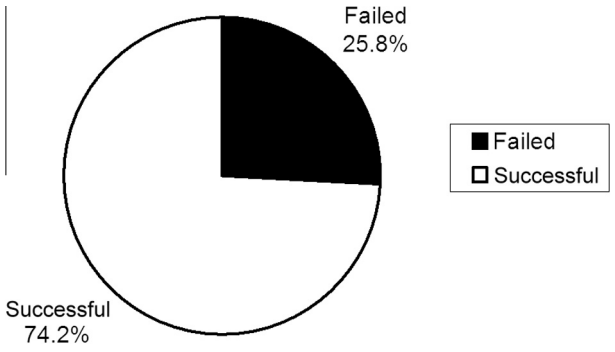


**Figure 1** Outcome of chest ultrasound in the studied group.