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BRIEF REPORT

Diagnostic Accuracy of Chest x-Ray and Ultrasonography in Detection of Community Acquired Pneumonia; a Brief Report

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Received: November 2014; Accepted: January 2015

Abstract

Introduction: Chest x-ray (CXR) is the simplest diagnostic tool of Community Acquired Pneumonia (CAP), but it has some limitation. Therefore, the aim of this study is comparing the diagnostic accuracy of CXR and chest ultrasonography (CUS) in detection of CAP. **Methods:** In the present study, a consecutive sample of suspected patients with CAP was underwent CUS, CXR, and chest computed tomography (CT) scan. Diagnostic accuracy of CUS and CXR was assessed by calculating the sensitivity, specificity, predictive values, and likelihood ratios using SPSS 20 statistical software. **Results:** 30 patients with CAP were enrolled (93.3% male with mean age of 63.8 ± 18.3 years). Sensitivity of CUS and CXR in detection of CAP were 100.0% (95% Cl: 85.4-100.0) and 93.1% (95% Cl: 75.8-98.8), respectively. Specificity of CXR was 0.0 (95% Cl: 0.0-94.5), while the CUS specificity was not calculable. **Conclusion:** Findings of the present study demonstrated on the higher diagnostic accuracy of CUS versus CXR in detection of pneumonia.

Key words: Pneumonia; ultrasonography; emergency department; radiography, thoracic; tomography, x-ray computed

Cite this article as: Taghizadieh A, Ala A, Rahmani F, Nadi A. Diagnostic accuracy of chest x-ray and ultrasonography in detection of community acquired pneumonia; a brief report. Emergency. 2015;3(3):114-16

Introduction:

Community acquired pneumonia (CAP) is one of the main concerns of health services which only causes to 1.7 million cases of hospitalization annually in the United States (1, 2). It is one of the most common infectious diseases and important causes of mortality and morbidity in worldwide (3). Streptococcus pneumonia, Hemophilic influenza, and Moraxella catarrhalis are typical bacterial pathogens in approximately 85% of CAP cases (4). The presentation of CAP includes fever, cough, and pleuritic chest pain. Beside the physical examination, chest x-ray (CXR), as the simplest diagnostic tool, is suggested to exclude conditions mimic CAP (1). However, CXR findings may be negative in patients if CAP presents at early stages of the disease. Moreover, noticing to high costs and the need for more irradiation, the routine usage of computed tomography (CT) Scan in diagnosis of pneumonia in emergency departments is not recommended (5). Ultrasonography (CUS) has been recently applied in detection of pulmonary diseases such as pulmonary edema, pulmonary embolisms, pericardial and pleural effusion, and pneumothorax (6, 7). However, only few data have been published to show its efficiency in detecting pneumonia. Therefore, the aim of this study was evaluating diagnostic accuracy of CXR and CUS in findings of pneumonia.

Methods:

Study design and setting

The present study was conducted to evaluate diagnostic accuracy of CUS and CXR in detection of pneumonia. It was performed in the emergency department (ED) of Imam Reza Medical Research and Training Hospital, Tabriz, East Azerbaijan, Iran, through February to April 2014. The local Ethical Committee of Tabriz University of Medical Sciences approved the protocol of the study and written consent was obtained from all patients after describing the aims and methods of the study. The consecutive samples of suspected CAP patients were underwent CUS, CXR, and CT scan. Presence of fever, cough, pleuritic pain, sputum production, and dyspnea were considered as signs and symptoms of CAP (8). Patients with asthma, acute coronary syndrome, septic shock,

Table 1: Diagnostic accuracy of chest ultrasonography and radiography in detection of pneumonia and plural effusion (95% confidence interval)

Diagnostic test	Pneumonia	Plural effusion
Ultrasonography		
Sensitivity	100.0 (85.4-100.0)	92.3 (62.1-99.6)
Specificity	NaN	100.0 (77.1-100.0)
Positive predictive value	100.0 (85.4-100.0)	100.0 (70.0-100.0)
Negative predictive value	0.0 (0.0-14.5)	94.4 (70.6-99.7)
Positive likelihood ratio	NaN	NaN
Negative likelihood ratio	NaN	0.08 (0.01-0.5)
Radiography		
Sensitivity	93.1 (75.8-98.8)	66.7 (35.4-88.7)
Specificity	0.0 (0.0-94.5)	77.8 (51.9-92.6)
Positive predictive value	96.4 (79.8-99.8)	66.7 (35.4-88.7)
Negative predictive value	0.0 (0.0-80.2)	77.8 (51.9-92.6)
Positive likelihood ratio	0.93 (0.84-1.03)	3.0 (1.2-7.8)
Negative likelihood ratio	NaN	0.4 (0.2-1.0)

pulmonary embolism, chronic obstructive pulmonary disease (COPD), cardiac and pleural disorders were excluded. After clinical examinations, Patients with clinical suspicion of CAP underwent CXR, CUS, and chest CT scan. Clinical examinations and CUS were done with bedside machine available in the ED (GH Healthcare; LOGIQ 200, PRO series; Korea) with a convex 3.5-MHz transducer by a trained emergency medicine specialist. Then, patient referred to radiology unit to perform CXR and chest CT scan (as a gold standard) with Toshiba Asteion 16 slices scanner with considering one-millimeter distance between image slices. The radiography and CT scan findings were interpreted by a radiologist blinded to clinical examinations. Data was analyzed using SPSS 20 software. Diagnostic accuracy of CUS and CXR were assessed by calculating the sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios.

Results:

We studied imaging findings of 30 patients with clinical suspicion of community-acquired pneumonia (93.3% male, mean age 63.8±18.3 years). CT scan findings showed 29 (96.7%) cases of pneumonia, while CUS revealed the diagnosis of pneumonia for all 30 cases (1 case of false positive). CXR also showed 28 (93.3%) pneumonia cases (2 false negative and 1 false positive) (Table1). The sensitivity of CUS in pneumonia detection was calculated 100.0% (95% CI: 85.4-100.0), but its specificity was not calculable because of being positive of all subjects. However, sensitivity and specificity of CXR in pneumonia detection were 93.1% (95% CI: 75.8-98.8) and 0.0% (95% CI: 0.0-94.5), respectively. Based on CT scan findings, finally 13 (43.3%) cases had evidence of pleural effusion. CUS detected 12 (40%) subjects (1 false negative), while CXR could only detect 8 (26.7%) patients (4 false positive and 4 false negative). Sensitivity and specificity of CUS in detection of pleural effusion were 92.3% (95% CI: 62.1-99.6) and 100.0% (95% CI: 77.1-100.0), respectively. Sensitivity and specificity of CXR were also 66.7% (95% CI: 35.4-88.7) and 77.8% (95% CI: 51.9-92.6), respectively (Table 1).

Discussion:

Findings of the present study demonstrated that diagnostic accuracy of CUS in detection of pneumonia and plural effusion were higher than CXR. Several studies stated that CUS is a simple, fast, and effective diagnostic tool for detection of pulmonary diseases. For example, in a study done by Mathis and colleagues, authors recommended that ultrasonography is the simplest and most sensitive imaging tool for measurement of pleural fluid (9). Bsrilleni and colleagues concluded that ultrasonography is a useful and reliable method in diagnosing the pulmonary diseases (10). In another study conducted by Lichtenstein et al., it was stated that CUS is a fast and cost effective method in detecting pulmonary diseases, without radiation exposure (11). Neesse and colleagues evaluated the results of CXR in pulmonary diseases and concluded that ultrasonography is a rapid tool in detecting the pulmonary diseases, leads to accurate diagnosis in 68% of cases (12). These findings are along with Advanced Trauma Life Support (ATLS), represented that ultrasonography can be used in detection of abdominal free fluid, organ trauma, and pneumothorax. However, it should be considered that ultrasonography is highly operator dependent. One of the most important solving is the exact and long-term training of ED specialists regarding performing and interpreting of ultrasonography finding.

The small sample size was the limitation of this study and consequently specificity of CUS was not calculable. In addition, the small sample size caused that no true negative case was seen by CXR; therefore, the power of

calculated specificity of CXR was week. The CUS operator was not blind to the clinical presentation of patients, while the radiologist did not aware from the clinical presentation of patients and less diagnostic accuracy of CXR might be derived from that.

Conclusion:

Finding of the present study demonstrates that diagnostic accuracy of CUS in detection of pneumonia and plural effusion were higher than CXR.

Acknowledgments:

The authors are grateful to all the health personnel, data collectors, supervisors, administrative staff of the Emergency Department of Imam Reza Hospital, and patients participated in the study. This article was written based on a dataset of medical doctor thesis, registered in Tabriz University of Medical Sciences.

Conflict of interest:

None

Funding support:

None

Authors' contributions:

All authors have read and approved the manuscript .Ali Taghizadieh, Alireza Ala, and Akbar Nadi performed the data collection, literature review, and drafting of the manuscript. Farzad Rahmani undertook the major parts of the study design and performed the statistical analysis.

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