

Research Article

Lung Ultrasound is Comparable with Chest Roentgenogram for Diagnosis of Community-Acquired Pneumonia

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ABSTRACT

Background: The chest X-ray is routinely requested for patients with suspected pneumonia, but has been demonstrated to be an insensitive method with relatively low accuracy. The present study was conducted to compare the lung ultrasound and standard chest X-ray for diagnosing pneumonia.

Materials and Methods: In this hospital-based study 80 patients were enrolled for the study with acute respiratory complaints. All participants underwent a standard CXR before ward admission. An upright posteroanterior chest radiograph was performed. CXR images were subsequently interpreted by an experienced radiologist. Immediately after admission, a bedside LUS was performed. The ultrasonographic diagnosis of pneumonia was made by operator. The final diagnosis was made by a skilled physician who reviewed the clinical and laboratory findings and disease course independently of LUS and CXR results. The level of statistical significance was set at $P \leq 0.05$. The Data were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS).

Results: In the present study total patients were 80. Pneumonia was present in 48 females and in 32 males. In this study chest X-ray and lung Ultrasound was compared. Chest X-ray shows that true positive pneumonia was present in 34 patients while lung ultrasound shows that true positive pneumonia was present in 58 patients.

Conclusion: The present study concluded that lung Ultrasound was more accurate than chest X-ray.

Keywords: Pneumonia, Chest X-Ray and Lung Ultrasound.

INTRODUCTION

Pneumonia is one of the leading causes of death worldwide, and in low-income countries, it is the leading cause of death.¹ Pneumonia has been documented as a forgotten killer for human health. According to the data released by World Health Organization, lower respiratory tract infection is the leading cause of infectious disease related mortality worldwide and refers to the top-ranking death reason in low-income countries.² Despite the rapid advances of therapeutic strategy, community acquired pneumonia (CAP), hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP) remain dramatic clinical burden. The signs and symptoms localizing to the respiratory system, commonly referring as dyspnea, cough and fever, laboratory alterations (leukocytosis and increased c-reactive protein/procalcitonin) in conjunction

with radiographic pulmonary infiltrate, point to convincing diagnosis of pneumonia.^{3,4} These deaths may be prevented by early detection and targeted antibiotic therapy.⁵ However, the diagnosis of pneumonia is not always clear on presentation to health care facilities. Imaging usually includes a chest X-ray or, in some cases, a thoracic computed tomography (CT) scan. While the latter has the highest sensitivity, it is associated with high costs and higher doses of radiation.^{6,7} Because of these limitations, chest X-ray continues to be the main diagnostic modality for pneumonia despite its low sensitivity (43–78%).⁷⁻¹¹ The present study was conducted to compare the lung ultrasound and standard chest X-ray for diagnosing pneumonia.

MATERIALS AND METHODS

In this hospital-based study; 80 patients were enrolled for the study with acute respiratory

complaints. Before the commencement of the study ethical approval was taken from the Ethical committee of the institute and written informed consent was obtained from the patients. Patients if they had at least one of the following acute symptoms: dyspnea, cough, hemoptysis, and atypical chest pain (i.e., pleuritic pain), Unexplained fever without extrathoracic symptoms and localized absence of breath sounds or crackles on lung auscultation were included in the study. Patients with known chronic respiratory symptoms, and/or lung cancer were excluded from the study. All participants underwent a standard CXR before ward admission. An upright posteroanterior chest radiograph was performed. In other case (i.e., severe mobility limitation and dementia), an anteroposterior supine radiograph was performed. Lateral chest radiographs were performed only in those subjects who were fully able to cooperate and

maintain upright posture without assistance. CXR images were subsequently interpreted by an experienced radiologist. Immediately after admission, a bedside LUS was performed by trained internal and emergency medicine physicians. LUS was performed in the sitting position whenever possible. For patients with severe mobility limitations, 2 operators were involved (one performing LUS and the other helping the patient to maintain the sitting position). The ultrasonographic diagnosis of pneumonia was made by operator. The final diagnosis was made by a skilled physician who reviewed the clinical and laboratory findings and disease course independently of LUS and CXR results. Data were expressed as mean \pm standard deviation (SD). The level of statistical significance was set at $P \leq 0.05$. The Data were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS).

Table 1: Distribution of patient according to gender

Gender	N
Male	32
Female	48
Total	80

Table 2: Comparison of Chest X-ray and Lung Ultrasound

Parameter	Imaging Modality	
	Chest X-ray (N)	Lung Ultrasound (N)
True positive pneumonia	34	58
True negative pneumonia	16	10
False positive pneumonia	21	8
False Negative results	11	4

RESULTS

In the present study total patients were 80. Pneumonia was present in 48 females and in 32 males. In this study chest X-ray and lung Ultrasound was compared. Chest X-ray shows that true positive pneumonia was present in 34 patients while lung ultrasound shows that true positive pneumonia was present in 58 patients.

DISCUSSION

The chest X-ray is routinely recommended as an important diagnostic modality for pneumonia because it can predict pneumonia without clinical signs.¹² Likewise, lung ultrasound is successful in the differential diagnosis of atelectasis and lung consolidation¹³, because fluid or solid material that accumulates in the lung can be easily visualized by a transthoracic sonograph.¹⁴ In the present study total patients were 80. Pneumonia was present in 48 females

and in 32 males. In this study chest X-ray and lung Ultrasound was compared. Chest X-ray shows that true positive pneumonia was present in 34 patients while lung ultrasound shows that true positive pneumonia was present in 58 patients. In recent meta-analyses, Long et al. found a pooled sensitivity of 88% for lung ultrasound and Ye et al. found a pooled sensitivity of 95%.^{15,16} LUS has also been demonstrated to be highly accurate in the detection of parenchymal consolidation in patients with acute respiratory failure admitted to ICUs.^{17,18} The diagnostic performance of LUS is in fact superior than that of CXR in this setting,¹⁹ and even comparable to that of contrast-enhanced CT in its ability to detect pulmonary edema, asthma, and COPD, and to raise the clinical suspicion of pulmonary embolism.²⁰⁻²² Ultrasound missed pneumonia in four patients. These pneumonias were also

missed by chest X-ray. In all four patients, the pneumonia was located in the middle of the lung parenchyma and did not extend to the pleura. This is similar to prior studies finding that lesions not extending to the pleura are missed by ultrasound.²³ Lung ultrasound was able to be performed and interpreted rapidly at the bedside. In this setting, given that chest X-ray took an average of nearly 2 h to be performed (not including print time and physician interpretation), bedside lung ultrasound can provide a quicker diagnosis with timely and appropriate therapy. Bedside chest ultrasound is also cheaper than chest X-ray, costing on average one third to half as much as chest X-ray and, therefore, providing a more sensitive test at reduced costs.²⁴

CONCLUSION

The present study concluded that pneumonia was more prevalent in females than males. And lung Ultrasound was more accurate than chest X-ray. Lung ultrasound is a non-invasive and simple method that could be used for the diagnosis of suspected pneumonia.

REFERENCES

- World Health Organization. The 10 leading causes of death by country income group 2017 [updated 2017. Available from: <http://www.who.int/mediacentre/factsheets/fs10/en/index1.html>].
- Wunderink RG, Waterer GW. Clinical practice. Community-acquired pneumonia. *N Engl J Med* 2014;370:543-51.
- Eccles S, Pincus C, Higgins B, et al. Diagnosis and management of community and hospital acquired pneumonia in adults: summary of NICE guidance. *BMJ* 2014;349:g6722.
- American Thoracic Society; Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med* 2005;171:388-416.
- Mortensen EM, Restrepo MI, Anzueto A, Pugh JA. Antibiotic therapy and 48-hour mortality for patients with pneumonia. *Am J Med*. 2006;119(10):859-64. doi: 10.1016/j.amjmed.2006.04.017.
- Brenner DJ, Hall EJ. Computed tomography—an increasing source of radiation exposure. *N Engl J Med*. 2007;357(22):2277-84. doi: 10.1056/NEJMra072149.
- Syrjala H, Broas M, Suramo I, Ojala A, Lahde S. High-resolution computed tomography for the diagnosis of community-acquired pneumonia. *Clin Infect Dis*. 1998;27(2):358-63. doi: 10.1086/514675.
- Hagaman JT, Rouan GW, Shipley RT, Panos RJ. Admission chest radiograph lacks sensitivity in the diagnosis of community-acquired pneumonia. *Am J Med Sci*. 2009;337(4):236-40. doi: 10.1097/MAJ.0b013e31818ad805.
- Self WH, Courtney DM, McNaughton CD, Wunderink RG, Kline JA. High discordance of chest x-ray and computed tomography for detection of pulmonary opacities in ED patients: implications for diagnosing pneumonia. *Am J Emerg Med*. 2013;31(2):401-5. doi: 10.1016/j.ajem.2012.08.041.
- Ye X, Xiao H, Chen B, Zhang S. Accuracy of lung ultrasonography versus chest radiography for the diagnosis of adult community-acquired pneumonia: review of the literature and meta-analysis. *PLoS One*. 2015;10(6):e0130066. doi: 10.1371/journal.pone.0130066.
- Liu XL, Lian R, Tao YK, Gu CD, Zhang GQ. Lung ultrasonography: an effective way to diagnose community-acquired pneumonia. *Emerg Med J*. 2015;32(6):433-38. doi: 10.1136/emermed-2013-203039.
- Copetti R and Cattarossi L: Ultrasound diagnosis of pneumonia in children. *Radiol Med*. 113:190-198. 2008.(In English, Italian).
- Lichtenstein D, Mezière G and Seitz J: The dynamic air bronchogram. A lung ultrasound sign of alveolar consolidation ruling out atelectasis. *Chest* 2009; 135:1421-25.
- Roic G: Lung ultrasound in the diagnosis of pediatric pneumonia: Are we ready for routine use? *Acta Med Acad* 2016; 45:82-3.
- Ye X, Xiao H, Chen B, Zhang S. Accuracy of lung ultrasonography versus chest radiography for the diagnosis of adult community-acquired pneumonia: review of the literature and meta-analysis. *PLoS One*. 2015;10(6):e0130066. doi: 10.1371/journal.pone.0130066.
- Long L, Zhao HT, Zhang ZY, Wang GY, Zhao HL. Lung ultrasound for the diagnosis of pneumonia in adults: a

- meta-analysis. *Medicine* (Baltimore) 2017;96(3):e5713. doi: 10.1097/MD.00000000000005713.
17. Lichtenstein DA, Lascols N, Mezière G, et al Ultrasound diagnosis of alveolar consolidation in the critically ill. *Intensive Care Med* 2004; 30:276-81.
18. Hew M, Corcoran JP, Harriss EK, et al The diagnostic accuracy of chest ultrasound for CT-detected radiographic consolidation in hospitalised adults with acute respiratory failure: a systematic review. *BMJ Open* 2015; 5:e007838.
19. Xirouchaki N, Magkanas E, Vaporidi K, et al Lung ultrasound in critically ill patients: comparison with bedside chest radiography. *Intensive Care Med* 2011; 37:1488-93.
20. Lichtenstein DA, Mezière GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure. The BLUE Protocol. *Chest* 2008; 134:117-25.
21. Koenig S, Chandra S, Alaverdian A, et al Ultrasound assessment of pulmonary embolism in patients receiving CT pulmonary angiography. *Chest* 2014; 145:818-23.
22. Sekiguchi H, Schenck LA, Horie R, et al Critical care ultrasonography differentiates ARDS, pulmonary edema, and other causes in the early course of acute hypoxemic respiratory failure. *Chest* 2015; 148:912-8.
23. Reissig A, Copetti R, Mathis G, Mempel C, Schuler A, Zechner P, et al. Lung ultrasound in the diagnosis and follow-up of community-acquired pneumonia: a prospective, multicenter, diagnostic accuracy study. *Chest*. 2012;142(4):965-72. doi: 10.1378/chest.12-0364.
24. Jones BP, Tay ET, Elikashvili I, Sanders JE, Paul AZ, Nelson BP, et al. Feasibility and safety of substituting lung ultrasonography for chest radiography when diagnosing pneumonia in children: a randomized controlled trial. *Chest*. 2016;150(1):131-8. doi: 10.1016/j.chest.2016.02.643.