

# Comparative Analysis of Lung Ultrasound and Standard Chest X-Ray for Diagnosing Pneumonia at a Tertiary Care Hospital

Rajeev Nagi<sup>1</sup>, Sharad Antiram Dhurve<sup>2\*</sup>

<sup>1</sup>Associate Professor, Department of Radiodiagnosis,  
Prasad Institute of Medical Sciences, Banthara, Lucknow, Uttar Pradesh, India.

<sup>2</sup>Associate Professor, Department of General Medicine,  
Prasad Institute of Medical Sciences, Banthara, Lucknow, Uttar Pradesh, India.

## 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.

## \*Correspondence to:

**Dr. Sharad Antiram Dhurve,**  
Associate Professor,  
Department of General Medicine,  
Prasad Institute of Medical Sciences,  
Banthara, Lucknow, Uttar Pradesh, India.

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## INTRODUCTION

Pneumonia is one of the leading causes of death worldwide, and in low-income countries, it is the leading cause of death.<sup>1</sup> 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.<sup>2</sup>

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.<sup>3,4</sup>

These deaths may be prevented by early detection and targeted

antibiotic therapy.<sup>5</sup> 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.<sup>6,7</sup> Because of these limitations, chest X-ray continues to be the main diagnostic modality for pneumonia despite its low sensitivity (43–78%).<sup>7-11</sup> 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.<sup>12</sup> Likewise, lung ultrasound is successful in the differential diagnosis of atelectasis and lung consolidation<sup>13</sup>, because fluid or solid material that accumulates in the lung can be easily visualized by a transthoracic sonograph.<sup>14</sup>

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%.<sup>15,16</sup>

LUS has also been demonstrated to be highly accurate in the detection of parenchymal consolidation in patients with acute

respiratory failure admitted to ICUs.<sup>17,18</sup> The diagnostic performance of LUS is in fact superior than that of CXR in this setting,<sup>19</sup> 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.<sup>20-22</sup>

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.<sup>23</sup>

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.<sup>24</sup>

## 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.

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