



LUNG ULTRASOUND TO DETECT PNEUMONIA IN THE EMERGENCY DEPARTMENT

Emergency Medicine

Dr. Saptarshi Ghosh

Department of Emergency Medicine , Peerless Hospital And B.k. Roy Research Centre Kolkata.

Dr. Sonakshi Saha*

Department Of Emergency Medicine , Peerless Hospital And B.k. Roy Research Centre Kolkata.*Corresponding Author

Dr. Debarshi Jana

Institute of Post-graduate Medical Education And Research, A.j.c. Bose Road, Kolkata.

ABSTRACT

INTRODUCTION: Pneumonia is a frequent disease in adults, representing a major health care and economic problems, despite improvement in patient management, community acquired pneumonia remains a leading cause of world wide. **OBJECTIVES** The objective of the study is to see the sensitivity, specificity, and accuracy of lung ultrasound in diagnosing pneumonia in the emergency department. **MATERIALS AND METHODS** The study was a prospective, study. For the purpose of this proposal, a single centre based study was conducted at emergency department and critical care units of Peerless Hospital & B.K.Roy Research Centre, Kolkata. 124 patients with suspected pneumonia, present to our emergency medicine department, a lung ultrasound was performed on the patient, prior to the chest x rays and chest x-rays were read by radiologist. **RESULT** It was found that lung USG Sensitivity: 94.5, Specificity: 97.0, Positive Predictive Value: 98.9, Negative Predictive Value: 86.5 and Accuracy: 95.16 but lung X-ray Sensitivity: 79.1, Specificity: 97.0, Positive Predictive Value: 98.6, Negative Predictive Value: 62.7, Accuracy: 83.8%. **CONCLUSION** In conclusion, we believe that lung US in emergency physician hands, for the first approach to patients with pneumonia suspicion, could be an interesting tool for these patients' management in our setup.

KEYWORDS

Forensic, Palatal, Rugoscopy

INTRODUCTION:

Pneumonia is one of the leading causes of death worldwide, and in low-income countries, it is the leading cause of death 1. These deaths may be prevented by early detection and targeted antibiotic therapy 2. 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 3, 4. Because of these limitations, chest X-ray continues to be the main diagnostic modality for pneumonia despite its low sensitivity (43–78%)^{5,6,7,8}.

Several studies in high-income countries and one study by Liu et al. in China, a middle-income country, have shown ultrasound to be a reliable tool to diagnose pneumonia with a higher sensitivity and specificity than chest X-ray 8,9,10,11,12,13. Ultrasound is a safe, portable, and inexpensive diagnostic modality that is widely used in resource-limited countries 14. In remote areas with limited access to X-rays, clinicians are reliant on their physical examination, which also has limited sensitivity (47–69%), and therefore, ultrasound for diagnosing pneumonia has the potential to be very useful in this setting 15. Even in urban settings, use of bedside ultrasound can alleviate diagnostic dilemmas with critically ill patients, especially where facilities lack portable X-rays.^{16,17,18,19,20}

In 2008, the WHO reported the highest burden of pneumonia to be from Asia with the majority of the cases (43 million) from the Indian subcontinent, 21 million from China, 10 million from Pakistan, and additional high numbers in Bangladesh and Indonesia.²¹

The diagnosis of pneumonia was once thought to be confirmable simply by physical examination, history taking, and related methods. However, signs and symptoms cannot provide certainty about this diagnosis that needs an imaging examination to confirm. Recently, lung ultrasound (LUS), which is currently being used as a bedside method, has been shown to be useful for evaluating a range of pathologic pulmonary conditions. In fact, LUS has better sensitivity than chest radiography in pleural effusion diagnosis. In addition, several studies have demonstrated the application of ultrasound in the diagnosis of pneumonia, and the results have been significant.

The objective of the study is to see the sensitivity, specificity, and accuracy of lung ultrasound in diagnosing pneumonia in the emergency department.

MATERIALS AND METHODS

The study was a prospective, study. For the purpose of this proposal, a single centre based study was conducted at emergency department and critical care units of Peerless Hospital & B.K.Roy Research Centre, Kolkata.

124 patients with suspected pneumonia, present to our emergency medicine department, a lung ultrasound was performed on the patient, prior to the chest x rays and chest x-rays were read by radiologist.

Depending upon our findings we had seen the sensitivity, specificity, like hood ratio and accuracy of lung ultrasound in diagnosing pneumonia in the emergency department.

Statistical Analysis:

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 25.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate. p-value ≤ 0.05 was considered for statistically significant.

RESULT AND ANALYSIS

It was found that 8(6.5%) patients were ≤ 40 years old, 18(14.5%) patients were 41-50 years old, 37(29.8%) patients were 51-60 years old, 31(25.0%) patients were 61-70 years old and 30(24.2%) patients were 71-80 years old.

Our study showed that 49(39.5%) patients were female, 75(60.5%) patients were male. 91(73.4%) patients had positive pneumonia and 33(26.6%) patients had Negative pneumonia. In USG Test, 87(70.2%) patients had positive report and 37(29.8%) patients had negative report. In Chest X-ray Test, 73(58.9%) patients had positive report and 51(41.1%) patients had negative report. In CT-Scan Test, 4(19.0%) patients had positive report and 17(81.0%) patients had negative report.

We found that the mean Age (mean $\pm$ s.d.) of patients was 60.1452 $\pm$ 12.1211 years.

Our study showed that in Positive PNEUMONIA, 3(3.3%) patients were ≤ 40 years old, 10(11.0%) patients were 41-50 years old, 31(34.1%) patients were 51-60 years old, 23(25.3%) patients were 61-70 years old and 24(26.4%) patients were 71-80 years old. In Negative PNEUMONIA, 5(15.2%) patients were ≤ 40 years old, 8(24.2%)

patients were 41-50 years old, 6(18.2%) patients were 51-60 years old, 8(24.2%) patients were 61-70 years old and 6(18.2%) patients were 71-80 years old. Association of Age in Years vs pneumonia was statistically significant ($p=0.0273$).

It was found that in Positive PNEUMONIA, 36(39.6%) patients were female and 55(60.4%) patients were male. In Negative PNEUMONIA, 13(39.4%) patients were female and 20(60.6%) patients were male. Association of SEX vs pneumonia was not statistically significant ($p=0.9866$).

We found that 86(94.5%) patients had both positive report in USG and pneumonia but 32(97.0%) patients had both negative report in USG and pneumonia. Association of USG vs pneumonia was statistically significant ($p<0.0001$).

Our study showed that 72(79.1%) patients had both positive report in Chest X-ray and pneumonia but 32(97.0%) patients had both negative report in Chest X-ray and pneumonia. Association of Chest X-ray vs pneumonia was statistically significant ($p<0.0001$).

It was found that lung USG Sensitivity: 94.5, Specificity: 97.0, Positive Predictive Value: 98.9, Negative Predictive Value: 86.5 and Accuracy: 95.16 but lung X-ray Sensitivity: 79.1, Specificity: 97.0, Positive Predictive Value: 98.6, Negative Predictive Value: 62.7, Accuracy: 83.8%.

It was found that 4(80.0%) patients had both positive report in CT-Scan and pneumonia but 16(100.0%) patients had both negative report in CT-Scan and pneumonia. Association of CT-Scan vs pneumonia was statistically significant ($p<0.0001$).

Our study showed that in Positive Chest X-ray, 30(41.1%) patients were female and 43(58.9%) patients were male. In Negative Chest X-ray, 19(37.3%) patients were female and 32(62.7%) patients were male. Association of SEX vs Chest X-ray was not statistically significant ($p=0.6668$).

We found that 73(100.0%) patients had both positive report in USG and Chest X-ray but 37(72.5%) patients had both negative report in USG and Chest X-ray. Association of USG vs Chest X-ray was statistically significant ($p<0.0001$) and 17(81.0%) patients both had negative reports in CT-Scan vs Chest X-ray.

DISCUSSION

We found that 8(6.5%) patients were ≤ 40 years old, 18(14.5%) patients were 41-50 years old, 37(29.8%) patients were 51-60 years old, 31(25.0%) patients were 61-70 years old and 30(24.2%) patients were 71-80 years old. The mean Age (mean $\pm$ s.d.) of patients was 60.1452 ± 12.1211 years. 49(39.5%) patients were female and 75(60.5%) patients were male.

Cipollini F et al 22 (2018) found that 61 M and 67 F, age ranging from 78 to 94 yrs, mean 84.8 year.

Bitar ZI et al 23 (2019) found that of the 73 patients, 31 (42.5%) were male, with a mean age of 68.3 years, and a range of 27 to 94 years. Eleven (15%) patients had community acquired pneumonia, and 62 (85%) had hospital acquired pneumonia.

Karimi E et al 24 (2019) found that 280 patients with the mean age of 56.47 ± 19.79 (10 – 92) years were studied (57.1% male). Our study found that 91(73.4%) patients had positive pneumonia and 33(26.6%) patients had Negative pneumonia.

Present study found that In USG Test, 87(70.2%) patients had positive report and 37(29.8%) patients had negative report. In Chest X-ray Test, 73(58.9%) patients had positive report and 51(41.1%) patients had negative report.

Cipollini F et al 22 (2018) found that the sensitivity of LUS resulted in 82.03% (105/128) and those of CXR 75.78% (97/128); the difference was statistically not significant.

Cortellaro F et al 25 (2012) showed that the first CXR was positive in 54/81 patients (sensitivity 67%; 95% CI 56.4% to 76.9%) and negative in 33/39 (specificity 85%; 95% CI 73.3% to 95.9%), whereas lung ultrasound was positive in 80/81 (sensitivity 98%; 95% CI 93.3% to

99.9%) and negative in 37/39 (specificity 95%; 95% CI 82.7% to 99.4%).

Orso D et al 26 (2018) found that the pooled area under the curve, sensitivity, and specificity were, respectively, 97, 92, and 93%.

We found that 86(94.5%) patients had both positive report in USG and pneumonia but 32(97.0%) patients had both negative report in USG and pneumonia. Association of USG vs pneumonia was statistically significant ($p<0.0001$).

It was found that lung USG Sensitivity: 94.5, Specificity: 97.0, Positive Predictive Value: 98.9, Negative Predictive Value: 86.5 and Accuracy: 95.16.

Pagano A et al 27 (2015) found that all the patients underwent a CXR study, read by a radiologist, and an LUS, performed by a trained ED physician on duty. This study has shown sensitivity, positive predictive value and negative predictive value of LUS compared to the CXR study for the diagnosis of acute pneumonia. These results suggest the use of bedside thoracic US first-line diagnostic tool in patients with suspected pneumonia.

Unluer EE et al 28 (2013) found that the sensitivity, specificity, PPV, NPV, and the positive and negative likelihood ratios for BUS were 96.4%, 84.1%, 79.4%, 97.4%, 6.1 and 0.042, respectively. The diagnostic accuracy of BUS was 89%.

Corradi F et al 29 (2015) found that Quantitative ultrasonography showed higher sensitivity (93%), specificity (95%), and diagnostic accuracy (94%) than chest X-ray (64%, 80%, and 69%, resp.), visual ultrasonography (68%, 95%, and 77%, resp.), or their combination (77%, 75%, and 77%, resp.).

Bitar ZI et al 23 (2019) found that LUSs were positive in 31 of 32 patients with CT confirmed pneumonia (sensitivity 96%), and CXR was positive in 5 of 32 patients with CT confirmed pneumonia (sensitivity 15.6%).

72(79.1%) patients had both positive report in Chest X-ray and pneumonia but 32(97.0%) patients had both negative report in Chest X-ray and pneumonia. Association of Chest X-ray vs pneumonia was statistically significant ($p<0.0001$).

It was found that lung X-ray Sensitivity: 79.1, Specificity: 97.0, Positive Predictive Value: 98.6, Negative Predictive Value: 62.7, Accuracy: 83.8%.

73(100.0%) patients had both positive report in USG and Chest X-ray but 37(72.5%) patients had both negative report in USG and Chest X-ray. Association of USG vs Chest X-ray was statistically significant ($p<0.0001$).

CONCLUSION

We found that Lung USG has high accuracy in the diagnosis of pneumonia. Moreover, LUS has bedside availability and feasibility. Therefore, LUS may be a promising alternative to chest X-ray and chest CT when it is not inconvenient.

Considering the limitations of the present study, further close examinations are needed to assess the sensitivity and specificity of bedside lung USG in the diagnosis of pneumonia.

In conclusion, we believe that lung US in emergency physician hands, for the first approach to patients with pneumonia suspicion, could be an interesting tool for these patients' management in our setup.

Table: Association between USG, Chest X-ray, CT-Scan: pneumonia

		PNEUMONIA		TOTAL	Chi-square value	p-value
		Positive	Negative			
USG	Positive	86	1	87	96.7972	<0.0001
	Row %	98.9	1.1	100.0		
	Col %	94.5	3.0	70.2		
	Negative	5	32	37		
	Row %	13.5	86.5	100.0		
	Col %	5.5	97.0	29.8		

	TOTAL	91	33	124		
	Row %	73.4	26.6	100.0		
	Col %	100.0	100.0	100.0		
Chest X-ray	Positive	72	1	73	57.9090	<0.0001
	Row %	98.6	1.4	100.0		
	Col %	79.1	3.0	58.9		
	Negative	19	32	51		
	Row %	37.3	62.7	100.0		
	Col %	20.9	97.0	41.1		
CT-Scan	TOTAL	91	33	124	15.8118	<0.0001
	Row %	73.4	26.6	100.0		
	Col %	100.0	100.0	100.0		
	Positive	4	0	4		
	Row %	100.0	0.0	100.0		
	Col %	80.0	0.0	19.0		
	Negative	1	16	17		
	Row %	5.9	94.1	100.0		
	Col %	20.0	100.0	81.0		
	TOTAL	5	16	21		
	Row %	23.8	76.2	100.0		
	Col %	100.0	100.0	100.0		

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