EDITORIAL

Seeing is Believing: The Import of Lung Ultrasound!

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Ultrasound was a field often neglected until its use was discovered for imaging heart by cardiologists and rest of the body by radiologists. Lung ultrasound, a late entrant to the field, has changed the landscape of critical care medicine. It has now become a first-line bedside clinical tool and is now called the "new stethoscope". One of the early observational studies on lung USG lung ultrasound score (LUS) by Lichtenstein and Mezière on BLUE protocol suggested that anterior alveolar consolidations, anterior diffuse B lines with abolished lung sliding, anterior asymmetric interstitial patterns, posterior consolidations, or effusions without anterior diffuse B lines indicated pneumonia with 89% sensitivity and 94% specificity.[1]

Chest radiography (CXR) has been the mainstay for diagnosing pneumonia, but computed tomography (CT) has continued to be the gold standard for imaging the chest. However, CT has its own limitation. It is expensive, causes high radiation exposure, and it is not always feasible to shift critically ill patients to the CT suite. Long et al. in their meta-analysis included 1515 subjects who were randomized to CXR or chest CT prior to LUS. Pooled sensitivity and specificity for LUS were 0.88 (95% CI: 0.86–0.90) and 0.86 (95% CI: 0.83–0.88), respectively. The calculated pooled negative likelihood ratio (LR) was 0.13 (95% CI: 0.08–0.23), and the positive LR was 5.37 (95% CI: 2.76–10.43). The area under the curve (AUC) for LUS was 0.95, thus indicating the highly discriminatory ability of LUS.[2] Another meta-analysis and systemic review by Xia et al. had 1911 subjects. When CT alone, CT combined with clinical presentations and microbiology was set as the gold standard of pneumonia, respectively, LUS demonstrated a pooled sensitivity of 90.9%, 95.0%, and 53.3%, and a pooled specificity of 89.7%, 91.3%, and 67.9%. They also compared the diagnostic efficiency of LUS for pneumonia with CXR in 1343 patients with AUC for LUS and CXR was 0.972 and 0.867, respectively.[3]

Lung ultrasound score plays an important role in resource-limited settings which are common in low-middle-income countries (LMIC), as CT may not be feasible or available. In the study done in Nepal by Amatya et al., 62 patients were included, in the study, of whom, 44 (71%) were diagnosed with pneumonia by CT. Lung ultrasound score demonstrated a sensitivity of 91% compared with CXR that had a sensitivity of 73% ($p = 0.01$). Specificities of LUS and CXR were 61% and 50%, respectively.[4]

As the ultrasound devices are becoming more portable and affordable, LUS has served as an invaluable tool in this coronavirus disease-2019 (COVID-19) pandemic for rapid diagnosis and day-to-day monitoring. Jin et al. in an early literature on LUS in COVID-19 evaluated 20 confirmed COVID-19 patients from Xiangya Hospital and Peking Union Medical College Hospital in China. They found that the use of ultrasound provided similar results to those of CT and superior results to those of standard CXR.[5] The utility of LUS as in COVID-19 has further been appreciated in meta-analysis by Jari et al., which included 16 studies and 2105 patients. They found that pooled sensitivities for LUS and CT were 86.9% and 93.5%, respectively. However, the specificity of LUS was poor compared with CT, i.e., 62.4% and 72.6%, respectively.[6]

Nazerian et al. have also evaluated combined use of LUS and procalcitonin (PCT) for diagnosis of pneumonia. Sensitivity of the LUS/PCT test (96.7%) was significantly superior to LUS alone (85.2%) and PCT alone (73.8%) ($p < 0.05$ for both). The specificity of LUS/PCT (94%) was not significantly different from LUS alone (88.1%).[7]

In this edition, an observational, cross-sectional study by Dhawan and Singh studied the diagnostic accuracy of LUS with CXR in comparison with CT (gold standard) in patients (age >18 years) with suspected pneumonia and analyzed the characteristic patterns of sonographic findings of consolidation. They have found that LUS has significant diagnostic agreement with CXR and CT, however, CXR could not establish its accuracy with CT because of non-significant agreement. Sensitivities for LUS and CXR are 88.1% and 67.8%, respectively. Specificity was 100% for LUS, while it was zero for CXR. The AUC for LUS was 0.94 (95% CI: 0.0–1.0, p-value = 0.13), whereas for CXR, it was 0.66 (95% CI: 0.12–1.0, p-value = 0.58). Thus, they concluded that LUS has high sensitivity, specificity, and diagnostic accuracy in comparison with CXR.[8] There analysis for sensitivity and AUC is in concurrence with previous studies.[2–4] The difference in specificity (ability to correctly identify patients without the disease) between studies may originate from the fact that ultrasonography is highly operator-dependent, requires a learning curve, and interpretation may vary with the quality of image generated.

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The advent of portable, affordable ultrasound devices along with teleguidance, video-learning software, and information sharing, has improved patient care and operator training. Thus, LUS being an easy-to-perform and safe bedside imaging tool with good discriminatory ability has seen exponential increase in its use in intensive care units and emergency rooms over the years. The future of LUS will have deep learning algorithms that will aid in interpretation of the image generated and also help in monitoring any change in follow-up LUS scans. Presently, the lack of a large dataset of reliable LUS images in pneumonia to test the effectiveness of deep learning along with ethical and legal issues in application of artificial intelligence in real-world clinical scenarios are challenges that exist.

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References

1. Lichtenstein DA, Mezière GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure: the BLUE protocol. Chest 2008;134(1):117–125. DOI: 10.1378/chest.07-2800.
2. 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.0000000000005713.
3. Xia Y, Ying Y, Wang S, Li W, Shen H. Effectiveness of lung ultrasonography for diagnosis of pneumonia in adults: a systematic review and meta-analysis. J Thorac Dis 2016;8(10):2822–2831. DOI: 10.21037/jtd.2016.09.38.
4. Amatya Y, Rupp J, Russell FM, Saunders J, Bales B, House DR. Diagnostic use of lung ultrasound compared to chest radiograph for suspected pneumonia in a resource-limited setting. Int J Emerg Med 2018;11(1):8. DOI: 10.1186/s12245-018-0170-2.
5. Jin YH, Cai L, Cheng ZS, Cheng H, Deng T, Fan YP, et al. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version). Mil Med Res 2020;7(1):4. DOI: 10.1186/s40779-020-0233-6.
6. Jari R, Alfuraih AM, McLaughlan JR. The diagnostic performance of lung ultrasound for detecting COVID-19 in emergency departments: a systematic review and meta-analysis. J Clin Ultrasound 2022;50(5):618–627. DOI: 10.1002/jcu.23184.
7. Nazerian P, Cerini G, Vanni S, Gigli C, Zanobetti M, Bartolucci M, et al. Diagnostic accuracy of lung ultrasonography combined with procalcitonin for the diagnosis of pneumonia: a pilot study. Crit Ultrasound J 2016;8(1):17. DOI: 10.1186/s13089-016-0054-8.
8. Dhawan J, Singh G. Bedside Lung Ultrasound as an Independent tool to diagnose pneumonia in comparison to chest X-ray: An observational prospective study from intensive care units. Indian J Crit Care Med 2022;26(8):920–929.