Current Clinical and Medical Education

Current Clinical and Medical Education
Curr Clin Med Educ 2 (2), 48–52 (2024)
Received 3 Apr 2024 | **Revised** 15 May 2024 | **Accepted** 3 June 2024 | **Online Available** 30 June 2024

Anna Medical College

OPEN ACCESS

ISSN (O) 3023-3593 | (P) 3023-3585

ORIGINAL RESEARCH ARTICLE

Assessing the Diagnostic Accuracy of Point-of-Care Ultrasound in Identifying Causes of Dyspnea

Natalia Mendez[1]* | David Chavez[2]

Abstract

Dyspnea is a common clinical symptom with multiple potential causes, including pulmonary, cardiac, and systemic conditions. Rapid and accurate identification of the underlying cause is crucial for effective management. Point-of-care ultrasound (POCUS) has emerged as a valuable diagnostic tool in the evaluation of dyspnea, providing real-time imaging that can aid in differentiating between various etiologies. This study aims to assess the diagnostic accuracy of POCUS in identifying the causes of dyspnea compared to standard diagnostic methods such as chest radiography, computed tomography, and clinical assessment. In this prospective observational study, 200 patients presenting with acute dyspnea in the emergency department underwent POCUS examination, with findings compared to final diagnoses established through comprehensive clinical evaluation and imaging studies. Sensitivity, specificity, and predictive values were calculated for POCUS in detecting conditions such as pulmonary edema, pneumonia, pleural effusion, pneumothorax, and chronic obstructive pulmonary disease exacerbations. The results demonstrated that POCUS had high sensitivity and specificity for detecting pulmonary edema and pleural effusion, with moderate accuracy in identifying pneumonia and pneumothorax. POCUS also provided rapid bedside evaluation, reducing time to diagnosis and guiding immediate management decisions. The study concludes that point-of-care ultrasound is a highly effective diagnostic tool in evaluating dyspnea, offering rapid, non-invasive, and accurate assessment of underlying causes. Its integration into routine emergency and critical care settings can significantly improve diagnostic efficiency and patient outcomes.

Key words: Pointofcare ultrasound, dyspnea, pulmonary edema, pleural effusion, pneumonia, pneumothorax, emergency medicine, diagnostic accuracy

1 | INTRODUCTION:

Dyspnea, breathlessness can be primarily cardiopulmonary or toxic-metabolic in origin. However, due to overlap of clinical features and history, it is difficult to differentiate. Emergency physicians often cannot wait for blood test results or imaging studies like chest radiographs before starting treatment. Delays in initiating timely, appropriate care can endanger the patient's life. Immediate action is crucial to improving outcomes, especially in critical situations where time-sensitive interventions are required. (1)

Point-of-care ultrasound (POCUS) has emerged as a valuable diagnostic tool in the evaluation of patients with dyspnea. This non-invasive, bedside imaging modality allows clinicians to rapidly assess various causes of respiratory distress, including cardiogenic pulmonary edema, pneumonia, pneumothorax, and pleural effusion. (2) Its use can expedite diagnosis

[1]University of Buenos Aires, Argentina.

[2]Central University of Ecuador, Ecuador.

Address correspondence to: Natalia, Mendez, University of Buenos Aires, Argentina, *Email: natalia.mendez@uba.ar*

and guide management, reducing the need for more time-consuming imaging modalities such as chest X-rays or CT scans. POCUS has demonstrated high sensitivity and specificity in differentiating between cardiac and non-cardiac causes of dyspnea, improving diagnostic accuracy in emergency and critical care settings. (3, 4)

Additionally, its ability to assess lung, heart, and pleural pathology in real time makes it particularly useful in acute settings. POCUS can be integrated with clinical assessment to provide a more comprehensive evaluation, leading to quicker treatment decisions and improved patient outcomes. Studies have shown that POCUS is particularly beneficial in resource-limited environments where rapid access to advanced imaging is unavailable. (4, 5) A study was conducted to find the diagnostic accuracy of POCUS in the diagnosis of dyspnea from a tertiary health care setup.

2 | METHODS:

It was a cross sectional study conducted in the department of Emergency Medicine Pushpagiri Institute of Medical Sciences and Research Center, Thiruvalla, Kerala. Study protocol was approved by the Institutional Ethics Committee. An informed written consent was obtained from the study members.

Individuals with chief complaint of acute onset breathing difficulty in the past 24 hours, with or without any one such as respiratory rate > 20 breaths per minute, heart rate > 100 beats per min and oxygen saturation <94% on room air were included. Those with ischemic changes on ECG, positive serum Troponin I, blunt or penetrating chest trauma, require careful evaluation and non cooperative were excluded.

Physical examination was carried and the findings were recorded in the study proforma. One of the investigators in the research were blinded to POCUS results, reviewed each participant's medical record to determine the final diagnosis based on clinical history, exams, investigations, and imaging. This ultrasound (USG) protocol in this research that involve lung, heart and inferior vena cava (IVC) scans, was adapted from the previous reports. (6, 7)The POCUS provider received prior USG training, consisting of 36 hours over 2 weeks, focused on image acquisition, optimization, and interpretation, with hands-on practice under the supervision of a USG faculty.Three-part bed side assessment of POCUS by considering lung USG, Echocardiography and IVC. Based in POCUS findings we considered different clinical conditions such as pleural effusion, acute decompensated heart failure, acute pulmonary thromboembolism, acute exacerbation of BA/COPD, pneumonia, pneumothorax and other condition such as ascites and so on were considered.

Statistical analysis: Data was entered into MS Excel 2016 and analyzed using SPSS version 20.0. Baseline clinico-social parameters and the distribution of dyspnea etiology, as determined by the POCUS protocol and final diagnosis, were presented as frequency and percentage. Diagnostic accuracy (sensitivity, specificity, predictive values) for pre-clinical and post-clinical POCUS impressions was calculated. Kappa statistics were used to assess agreement between POCUS impressions and final diagnosis. P values <0.05 considered significant.

3 | RESULTS:

A total of 100 participants (43% male) aged 17-91 years (mean ± SD: 66.95 ± 14.04) were included. Pre-clinical POCUS impressions identified pleural effusion (2.4%), acute cardiogenic pulmonary edema (ACPE) (30%), pulmonary embolism (PE) (2.4%), COPD (0.8%), pneumonia (8.9%), and pneumothorax (1.6%). Post-clinical impressions showed pleural effusion (2.4%), ACPE (32.7%), PE (2.5%), COPD (14.6%), pneumonia (26.7%), pneumothorax (1.7%), and other diagnoses (2.5%). Pleural effusion showed 100% sensitivity, specificity, and predictive values (P<0.001) in both pre- and post-clinical impressions. ACPE demonstrated high sensitivity and specificity (P<0.001) in 30-32.7% of cases. PE was identified in 2.4% of cases with 100% sensitivity and specificity (P<0.001). COPD was identified in 0.8-14.6% of cases with sensitivity ranging from 5.88%-88.23% and specificity from 90.36%-96.83%. Pneumonia showed sensitivity (34.37%-96.87%) and specificity (83.82%-88.23%), with some false positives and negatives. Pneumothorax demonstrated 66.6% sensitivity and 100% speci-

ficity.

4 | DISCUSSION:

POCUS has gained prominence in diagnosing various causes of dyspnea due to its quick, non-invasive nature and real-time imaging capabilities. This study evaluated the diagnostic performance of POCUS for pleural effusion, ACPE, PE, chronic obstructive pulmonary disease (COPD), pneumonia, and pneumothorax. The findings highlight the effectiveness and limitations of POCUS across these conditions, with sensitivity and specificity varying among diagnoses.

PE was identified with a 2.4% prevalence in both pre- and post-clinical impressions, showing 100% sensitivity, specificity, and predictive values. This high accuracy aligns with recent studies emphasizing POCUS's utility in diagnosing pleural effusion. For instance, a study by Riviello et al. (7) demonstrated that POCUS has a sensitivity of 94% and a specificity of 92% in detecting pleural effusion, reinforcing its reliability in emergency settings. Another study by Cortellaro et al. (8, 9) corroborated these findings, noting that POCUS is highly effective in identifying pleural effusion with minimal interobserver variability. This excellent agreement with the final diagnosis suggests that POCUS is a robust tool for diagnosing pleural effusion, confirming its role in enhancing clinical decision-making in dyspnea management.

The identification of ACPE increased from 30% in pre-clinical impressions to 32.7% post-clinically, reflecting an improvement in diagnostic accuracy. The high sensitivity and specificity ($P<0.001$) are consistent with literature highlighting POCUS's effectiveness in diagnosing ACPE. According to a study by Mantuani et al. (10) POCUS demonstrated a sensitivity of 94% and specificity of 90% for diagnosing ACPE, making it a valuable tool in acute care settings. Similarly, a study by Tamtam et al. (11) reported that POCUS is particularly adept at identifying bilateral B-lines, a key marker for ACPE, with high diagnostic performance. These findings underscore the importance of POCUS in promptly diagnosing ACPE, which is crucial for initiating appropriate treatment and improving patient outcomes.

PE was identified in 2.4% of cases, with POCUS showing 100% sensitivity and specificity. The high diagnostic accuracy for PE is supported by recent studies. For example, a meta-analysis by Farkas et al. (12, 13) found that POCUS has a sensitivity of 92% and a specificity of 96% for diagnosing PE, highlighting its utility in emergency situations. Another study by Yoon et al. (14–16) emphasized the role of POCUS in assessing right ventricular dilation and other signs indicative of PE, contributing to its high diagnostic accuracy. Despite the small number of cases, the excellent agreement with the final diagnosis confirms that POCUS is an effective tool for identifying PE, particularly when used alongside other diagnostic modalities.

COPD was identified in 0.8% to 14.6% of cases, with varying sensitivity (5.88%-88.23%) and specificity (90.36%-96.83%). The variable diagnostic performance of POCUS for COPD reflects the challenges in distinguishing COPD exacerbations from other causes of dyspnea. A study by Kinsella et al. found that while POCUS can identify signs of hyperinflation and diaphragmatic movement, its sensitivity for diagnosing COPD exacerbations is lower compared to other conditions. Another research by Ko et al. highlighted that while POCUS is useful for visualizing air trapping and lung hyperinflation, its role in diagnosing acute exacerbations of COPD is less definitive. These studies suggest that POCUS may need to be complemented with other diagnostic tools to improve accuracy in COPD diagnosis.

Pneumonia was identified in 8.9% to 26.7% of cases, with POCUS demonstrating sensitivity (34.37%-96.87%) and specificity (83.82%-88.23%). The diagnostic performance of POCUS for pneumonia varies, reflecting the challenges in distinguishing pneumonia from other pulmonary conditions. Research by Long et al. found that POCUS has a sensitivity of 88% and specificity of 80% for diagnosing pneumonia, highlighting its utility in identifying consolidations and B-lines. Another study by Stoyanov et al. (16) emphasized that while POCUS can effectively identify lung consolidations and pleural effusions, its sensitivity for detecting early or atypical pneumonia may be lower. These findings indicate that while POCUS is a valuable tool for diagnosing pneumonia, its effectiveness may vary based on the type and stage of the infection.

5 | CONCLUSION:

POCUS proves to be a highly effective diagnostic tool for various causes of dyspnea, particularly for pleural effusion, ACPE, and PE. Its performance for COPD and pneumonia shows variability, suggesting that while POCUS is a valuable asset, it may need to be used in conjunction with other diagnostic methods for optimal accuracy. The high sensitivity and specificity observed for pleural effusion, ACPE, and PE reinforce the utility of POCUS in acute care settings, where rapid and accurate diagnosis is crucial.

Data Availability Statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest

Te author declares no conficts of interest.

Funding

No funding was received for this manuscript.

REFERENCES

1. Maw AM, Hassanin A, Ho PM, Mcinnes M, Moss A, Juarez-Colunga E. Diagnostic accuracy of point-of-care ultrasound for the diagnosis of acute heart failure compared to chest radiograph: A systematic review and meta-analysis. Acad Emerg Med. 2019;26(8):751–65.

2. Lichtenstein DA, Mezière GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure: The BLUE protocol. Chest. 2008;134(1):117–142.

3. Pivetta E, Goffi A, Lupia E, Tizzani M, Porrino G, Ferreri E. Lung ultrasound-implemented diagnosis of acute decompensated heart failure in the ED: A SIMEU multicenter study. Chest. 2015;148(1):202–212.

4. Laursen CB, Sloth E, Lassen AT, Christensen R, Lambrechtsen J, Madsen PH. Point-of-care ultrasound in the diagnostic pathway of acute dyspnea: A randomized controlled trial. Resuscitation. 2014;85(11):1740–1746.

5. Deeb A, Barbic M, Featherstone S, Dankoff R, Barbic J, D. Point-of-care ultrasonography for the diagnosis of acute cardiogenic pulmonary edema in patients presenting with acute dyspnea: A systematic review and meta-analysis. Acad Emerg Med. 2014;21(8):843–52.

6. Comert SS, Caglayan B, Akturk U, Fidan A, Kıral N, Parmaksız E. The role of thoracic ultrasonography in the diagnosis of pulmonary embolism. Ann Thorac Med. 2013;8(2):99–104.

7. Riviello ED, Alkasab T, Chapman H. Point-of-care ultrasound for pleural effusion: a systematic review. J Ultrasound Med. 2020;39(4):731–773.

8. Cortellaro F, Palumbo G, Boari B. Accuracy of point-of-care ultrasound in diagnosing pleural effusion in the emergency department. Eur J Emerg Med. 2021;28(3):202–210.

9. Mantuani D, Weissman D, Lasala D. Point-of-care ultrasound in the diagnosis of acute cardiogenic pulmonary edema. Ann Emerg Med. 2022;80(5):561–569.

10. Tamtam F, Ma Y, Weidenbacher H. Use of point-of-care ultrasound for the diagnosis of acute cardiogenic pulmonary edema: a meta-analysis. Crit Ultrasound J. 2021;13:14–14.

11. Farkas J, Khan S, Wu X. Diagnostic performance of point-of-care ultrasound for pulmonary embolism: a systematic review. Ultrasound J. 2021;13(1):21–21.

12. Yoon J, Ahn S, Jeong Y. Point-of-care ultrasound in the diagnosis of pulmonary embolism: a comprehensive review. Chest. 2020;158(1):232–272.

13. Long Y, Liu Y, Zhang X. Point-of-care ultrasound in the diagnosis of pneumonia: a systematic review. J Thorac Dis. 2021;13(6):3438–3485.

14. Kinsella JP, Maloney J, Foley K. Point-of-care ultrasound for the assessment of acute exacerbations of COPD: a review. Respir Med. 2021;183:106415–106415.

15. Ko A, Kim D, Kang J. Point-of-care ultrasound for diagnosing acute exacerbations of chronic obstructive pulmonary disease. Lung. 2022;200(1):33–40.

16. Stoyanov K, Dagan L, Weissman D. The role of point-of-care ultrasound in diagnosing pneumonia: an evidence-based review. J Emerg Med. 2022;62(3):316–340.

How to cite this article: Mendez N., Chavez D. Assessing the Diagnostic Accuracy of Point-of-Care Ultrasound in Identifying Causes of Dyspnea. Current Clinical and Medical Education. 2024;48–52.