EDITORIAL

Differentiating Cardiac and Pulmonary Causes of Dyspnea: Is Point-of-care Ultrasound the Ultimate Tool?

Mozammil Shafi

Keywords: Dyspnea, Dyspnea differentiation index, Point-of-care ultrasound.
Indian Journal of Critical Care Medicine (2022): 10.5005/jp-journals-10071-24098

Acute dyspnea is an extremely distressing symptom and one of the leading causes of emergency department (ED) visits worldwide.[1] A plethora of clinical conditions like cardiorespiratory, metabolic, traumatic, and allergic may result in acute dyspnea. Among them, cardiorespiratory illnesses like acute decompensated heart failure (ADHF), pneumonia, chronic obstructive respiratory disease (COPD), bronchial asthma, pulmonary embolism, etc. are the foremost causes of acute dyspnea.[2] While history and physical examination are indispensable tools for reaching the correct diagnosis, they may not be sufficient enough at times. Clinicians may need to order a battery of tests including but not limited to chest X-ray, computed tomography scan, blood gas analysis, electrocardiography, N terminal pro-brain natriuretic peptide levels, and cardiac enzymes.[3] In differentiating acute exacerbation of COPD and ADHF, X-ray and electrocardiogram may not be sufficient enough for the correct diagnosis often leading to the prescription of harmful dual therapy by clinicians.[4]

In order to immediately ascertain the cause of dyspnea, ED clinicians often rely on various point-of-care tests. Peak expiratory flow rate (PEFR) is a commonly used test in ED for assessing the severity of bronchial asthma. Dyspnea discrimination index (DDI) and dyspnea discrimination index percentage are parameters proposed for reliably differentiating dyspnea of cardiac and respiratory origin and are derived from PEFR and PEFR%, respectively. DDI is the product of PEFR and partial pressure of oxygen (PO_2) divided by 1000. Both PEFR and DDI can be a good adjunct to clinical examination and chest imaging in rapidly differentiating dyspnea of cardiac and pulmonary origin.[5] Compared to dyspnea of cardiac origin the value of PEFR and DDI tend to be lower than that of pulmonary origin. Both PEFR and DDI were able to differentiate dyspnea of cardiac and pulmonary origin in 72 and 79%, respectively, in contrast to 69% by ED physician.[6]

Point of care ultrasound examination (POCUS) has recently revolutionized the management of acutely breathless patients in ED. Focused POCUS examination of various systems (cardiac, lungs, venous, etc.) helps in rapidly reaching the diagnosis in this cohort of patients. Kajimoto et al. evaluated the potential of lung cardiovascular inferior vena cava (LCI) scan in rapidly differentiating ADHF from pulmonary causes in an ED setting. LCI integrated scan has excellent sensitivity, specificity, positive and negative predictive values (94.3, 91.9, 94.3, and 91.9%, respectively).[7] Many studies have consistently shown that integrating multisystem POCUS with clinical examination expedites the etiological diagnosis of acute dyspnea in ED.[8–10]

In the present issue of this journal, Gina Maryann Chandy et al. conducted a single-center prospective study evaluating DDI and ultrasonography in discriminating cardiac and pulmonary causes of dyspnea. This study was conducted over 1-year period in a 2,700-bedded tertiary care teaching hospital at Vellore, India. They included all the patients of acute onset breathlessness or worsening of chronic breathlessness presenting to ED without any other obvious noncardiorespiratory cause of breathlessness. A total of 80 patients were assessed for eligibility. They measured PEFR, %PEFR, and derived DDI and % DDI in all patients except those unable to perform PEFR measurement. All patients underwent lung, cardiac, and inferior vena cava (LCI) scanning by the primary investigator. The investigators measured inferior vena cava (IVC) and its variability with respiration, calculated approximate ejection fraction, and scanned different lung zones using a specific protocol. The mean value of DDI and DDI percentage was lower in patients with dyspnea of pulmonary origin compared to cardiac origin (5.47 vs 8.34 for DDI and1.31 vs 2.34 for DDI percent, *p* value 0.0001). The sensitivity and specificity of DDI are 77.3 and 70%, respectively, while it is 72.7 and 72% for DDI%. On the contrary, ultrasound demonstrated an outstanding sensitivity and specificity of 98 and 95.3%, respectively. It is noteworthy that ultrasound is also found to have an excellent positive and negative predictive value (98 and 95.5%, respectively).

The result of the present study is comparable to the previous studies with few noticeable differences. The current study is comparable to the previous one's vis-à-vis reasonable overall diagnostic accuracy of PEFR, PEFR%, DDI, and DDI% in differentiating dyspnea of cardiac and pulmonary origin. The current study shows that the PEFR% has better diagnostic accuracy compared to PEFR. On the contrary, DDI (sensitivity 77.3%) is a marginally better sensitive parameter compared to DDI% (sensitivity 72.7%). It is hard to fathom why DDI was found to be more sensitive compared to DDI% despite PEFR% being more sensitive than PEFR. Another notable difference

Department of Intensive Care Unit, King Salman Hospital, Riyadh, Saudi Arabia

Corresponding Author: Mozammil Shafi, Department of Intensive Care Unit, King Salman Hospital, Riyadh, Saudi Arabia, Phone: +966 591507469, e-mail: mozammil.shafi@gmail.com

How to cite this article: Shafi M. Differentiating Cardiac and Pulmonary Causes of Dyspnea: Is Point-of-care Ultrasound the Ultimate Tool? Indian J Crit Care Med 2022;26(1):7–8.

Source of support: Nil

Conflict of interest: None

© The Author(s). 2022 Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and non-commercial reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

between the present study and its predecessor is the excellent diagnostic accuracy of clinical examination (82.5%). That may be explained by the fact the present study was conducted in one of the best tertiary care hospitals with well-experienced clinicians.

The present study reemphasizes the findings of Kajimoto et al. and other authors regarding the excellent diagnostic accuracy of ultrasound in differentiating various causes of breathlessness. Although this study did not compare DDI and ultrasonography (USG) the massive gap between their diagnostic accuracies puts ultrasound in pole position. Ultrasound can reliably differentiate between various pulmonary causes of dyspnea compared to DDI which can only tell whether the dyspnea is of cardiac or pulmonary origin. Besides that, measurement of PEFR is practically not possible when a patient is uncooperative due to severe respiratory distress. Ultrasound is portable, has a low learning curve, and eliminates the need of transporting patients to the radiology department. Getting a portable ultrasound machine and training the clinicians in POCUS examination is still a stumbling block in the resource-poor settings. In my view, multisystem POCUS examination is an excellent bedside tool in the armamentarium of ED physicians for rapidly elucidating the cause of dyspnea. The role of PEFR and DDI is less clear when an expert ED clinician trained in POCUS examination is available.

Orcid

Mozammil Shafi https://orcid.org/0000-0001-7132-1598

References

1. Logeart D, Saudubray C, Beyne P, Thabut G, Ennezat PV, Chavelas C, et al. Comparative value of Doppler echocardiography and B-type natriuretic peptide assay in the etiologic diagnosis of acute dyspnea. J Am Coll Cardiol 2002;40(10):1794–1800. DOI: 10.1016/s0735-1097(02)02482-8.
2. Ray P, Birolleau S, Lefort Y, Becquemin MH, Beigelman C, Isnard R, et al. Acute respiratory failure in the elderly: etiology, emergency diagnosis and prognosis. Crit Care 2006;10(3):R82. DOI: 10.1186/cc4926.
3. Weintraub NL, Collins SP, Pang PS, Levy PD, Anderson AS, Arslanian-Engoren C, et al. Acute heart failure syndromes: emergency department presentation, treatment, and disposition: current approaches and future aims: a scientific statement from the American Heart Association. Circulation 2010;122(19):1975–1996. DOI: 10.1161/CIR.0b013e3181f9a223.
4. Dharmarajan K, Strait KM, Lagu T, Lindenauer PK, Tinetti ME, Lynn J, et al. Acute decompensated heart failure is routinely treated as a cardiopulmonary syndrome. PLoS One 2013;8(10):e78222. DOI: 10.1371/journal.pone.0078222.
5. Malas O, Cağlayan B, Fidan A, Ocal Z, Ozdoğan S, Torun E. Cardiac or pulmonary dyspnea in patients admitted to the emergency department. Respir Med 2003;97(12):1277–1281. DOI: 10.1016/j.rmed.2003.07.002. PMID: 14682407.
6. Ailani RK, Ravakhah K, DiGiovine B, Jacobsen G, Tun T, Epstein D, et al. Dyspnea differentiation index: a new method for the rapid separation of cardiac vs pulmonary dyspnea. Chest 1999;116(4):1100–1104. DOI: 10.1378/chest.116.4.1100. PMID: 10531178.
7. Kajimoto K, Madeen K, Nakayama T, Tsudo H, Kuroda T, Abe T. Rapid evaluation by lung-cardiac-inferior vena cava (LCI) integrated ultrasound for differentiating heart failure from pulmonary disease as the cause of acute dyspnea in the emergency setting. Cardiovasc Ultrasound 2012;10(1):49. DOI: 10.1186/1476-7120-10-49. PMID: 23210515; PMCID: PMC3527194.
8. Pirozzi C, Numis FG, Pagano A, Melillo P, Copetti R, Schiraldi F. Immediate versus delayed integrated point-of-care-ultrasonography to manage acute dyspnea in the emergency department. Crit Ultrasound J 2014;6(1):5. DOI: 10.1186/2036-7902-6-5. PMID: 24940478; PMCID: PMC4039047.
9. Gallard E, Redonnet JP, Bourcier JE, Deshaies D, Largeteau N, Amalric JM, et al. Diagnostic performance of cardiopulmonary ultrasound performed by the emergency physician in the management of acute dyspnea. Am J Emerg Med 2015;33(3):352–358. DOI: 10.1016/j.ajem.2014.12.003. PMID: 25572643.
10. Chandy GM, Sathyendra S, Pichamuthu K, Hazra D, Abhilash KPP. Differentiating Cardiac and Pulmonary Causes of Dyspnea Using Ultrasonography and Dyspnea Discrimination Index. Indian J Crit Care Med 2021;26(1):33–38.