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Point of care ultrasound as initial diagnostic tool in acute dyspnea patients in the emergency department of a tertiary care center

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Abstract---Background: 1 of frequent symptoms that patients report to the emergency department has been dyspnea. In addition to clinical evaluation, a wide range of differentials frequently needs laboratory & radiographic tests, adding needless delay. Point-of-care in emergency departments, ultrasonography has been widely used tool as it can quickly & safely diagnose studied cases of dyspnea. Our research aimed to find out if point-of-care ultrasound has been used in our settings as primary diagnostic tool for patients with acute dyspnea. Summary: Dyspnea is 1 of the common problems that patients present to the ER. Wide variety of differentials typically calls for laboratory and radiographic investigations, causing final diagnosis to be delayed needlessly. In emergency rooms, point-of-care ultrasonography is popular tool since it can quickly & safely diagnose these dyspnea patients while also saving time. The goal of the study had been to determine whether point-of-care ultrasound had been useful in examining cases with acute dyspnea in settings as the main diagnostic tool.

Keywords---Point of care, ultrasound, diagnostic tool, dyspnea, emergency, tertiary care center.

Introduction

Dyspnea has been 1 of common alarming & incapacitating symptoms that examined cases report to the emergency room. The incidence of cases evaluated who report to the emergency room with dyspnea as their principal symptom varies from 0.9 to 7.4 percent in different areas, with incidence of five percent in Asia Pacific region (1).

Dyspnea has been expressed as "subjective experience of breathing discomfort comprised of qualitatively distinct sensations that vary in intensity" by American Thoracic Society. There are many conditions that can have dyspnea as their primary symptom. Early diagnosis is therefore required to assist in the right treatment of these cases and their discharge from the ED (2).

Even while careful history-taking and physical examination frequently yield correct diagnosis, in 30 to 50% of cases, additional diagnostic procedures may be required. A chest radiograph is usually used to assess the dyspneic condition, and occasionally other procedures like chest CT scans can be required later. These procedures subject the researched patients to radiation exposure and have not been appropriate for pregnancy examined cases. They have been reliant on resources offered by institutes (particularly CCT) & are only sometimes used in critically ill-studied cases. As a result, the emergency department wants early diagnostic tools to recognize studied cases & start targeted care (1).

Ultrasonography has been utilised as an image diagnostic method in clinical settings for more than 50 years. However, due to earlier concept of consultative ultrasonography & its restricted application in the diagnosis of respiratory disorders due to presence of artefacts, its use in emergency rooms was constrained. Three protocols had been developed: Bedside Ultrasound in Emergency protocol, Rapid Ultrasonography in Shock protocol, and Fluid Administration Limited by Lung Sonography protocol. These protocols had been designed to firmly establish use of lung ultrasound in critically ill patients for diagnosis in a wide range of situations as acute respiratory failure, undifferentiated hypotension, & guiding treatment like fluid therapy. With overall accuracy rate of 97.5 percent, emergency echocardiography by emergency physicians has been shown to provide significant information for studied instances of acute dyspnea (3).

Use of ultrasound as a diagnostic tool in a range of clinical and specialty situations, such as lung ultrasound, emergency echocardiography, and IVC assessment, is being supported by growing data. Since speedy diagnosis in the ED has been required, focused multidimensional ultrasound is being researched & used more frequently by emergency physicians. Most of this research has focused on recognizing the cardiovascular etiology of acute dyspnea. In cases with acute dyspnea in an emergency, lung-cardiac-inferior vena cava integrated ultrasonography may be able to distinguish between primary pulmonary disease and acute heart failure syndromes (4).

It has been currently unclear how to distinguish between cardiovascular and pulmonary diseases, as well as how to further divide different pulmonary pathologies. The evaluation of analyzed cases who present with acute dyspnea in the ED using PoCUS had been investigated. Since the distribution of distinct differentials has changed due to local variations in illness prevalence, it is not fair to apply the body of existing research to every circumstance consistently. Additionally, ultrasonography methodology varies depending on institutional procedure, producing different results in several studies (5).

Most frequent final composite diagnosis in the research sample had been pneumonia (n=188, 79.32percent). There had been regional differences in the proportional distribution of differential diagnoses for acute dyspnea and most common diagnostic criteria. PoCUS's specificity and sensitivity have been supported by prior literature. Examination revealed very similar sensitivity & specificity to the 2017meta-analysis carried out by Ling Long et al. (sensitivity85.6percent vs. 88percent & specificity87.7percent vs. 88percent). Also, both a positive likelihood ratio (6.99vs. 5.37) & a negative likelihood ratio (0.16vs. 0.13) had been comparable to pooled data. It had been comparable to research done subsequently by Zanobetti et al., where gold standard had been final diagnosis made by Emergency Medicinespecialists who had access to all studied case information throughout their hospital stay (sensitivity85.6 percent vs.88.5 percent & specificity87.7 percent vs. 91.6percent) (6).

Our research shows that PoCUS has a low negative predictive value (61.4percent) & may not completely rule out diagnosis of pneumonia. Acute pulmonary edoema had been the next most frequent diagnosis (n=35, 14.76percent). While specificity in this investigation was close to the literature (97.7percent vs. 98percent), sensitivity was lower when compared to the current literature (88.5percent vs. 97percent). Limited sensitivity exposed can be due to less precise diagnostic criteria for acute pulmonary edoema in our investigation (represented by several Blines, distribution of same number of windows), as well as differing diagnostic criteria in earlier researches. Additionally, the research's detectives were trained asEmergency MedicineResidents for 2months, leaving them with a learning curve to mastery. It will be easier to identify the reason for acute pulmonary edoema & streamline patient care if transthoracic echocardiography is added as component of PoCUSin research to identify LV dysfunction (sensitivity of 77.7 percent & a specificity of 96.9percent) or ACS (sensitivity50 percent & specificity100 percent). PoCUS has a strong negative predictive value of 98percent, demonstrating that it has been a reliable1st step in the diagnosis of acute pulmonary edoema (7).

In previous meta-analysis by Hansell et al., where CT scan had been regarded as gold standard, sensitivity & specificity to discover pleural effusion had been lower than in our study group (sensitivity 100percent vs. 91percent & specificity97.7 percent vs. 92percent). The difference between 2was because of various gold standards. In our study, not every case was subjected to a CT scan in the emergency department to establish the diagnosis for ED disposition. Because of PoCUS's extremely low positive predictive value of76.1 percent, it may not be regarded as reliable initial technique for pleural effusion diagnosis. However, research discovered that its significant 100% negative predictive value makes it useful tool for ruling out the diagnosis of pleural effusion (8).

Based on different lung ultrasound techniques utilised, the regions evaluated for specified outcomes, the ARDS diagnostic criteria, & gold standard used for comparison, the sensitivity of lung ultrasonography for the diagnosis of ARDS/ALI has varied. Although specificity (99.5percent) was good, sensitivity (28.5percent) had been quite poor. Due to the overlap of ultrasound characteristics in pneumonia & ARDS/ALI, it was difficult to do a contemporaneous diagnosis of both illnesses with PoCUS. ARDS/ALI can be diagnosed by PoCUS, which has

positive predictive value of 90.9 & negative predictive value of 88.9, according to our research. However, in the early stages, when it may be confused with pneumonia & when it's present alongside pneumonia, it may be challenging to distinguish (9).

1 of the most frequent symptoms for which patients visit the Emergency Department has been acute-onset dyspnea. Dyspnea is the primary cause of 4 to 5 million emergency department visits in the US each year, accounting for up to fifty percent of studied cases admitted to acute tertiary care hospitals. In Asia-Pacific region, five percent of all ED visits have been because of dyspnea. These examined cases continue to have a slightly high 30-day mortality rate (8-13percent) in addition to their high frequency. Therefore, a prompt and correct identification of the underlying illness is essential for early and effective therapy. Differential diagnosis has been usually challenging. Most doctors largely rely on standard diagnostic techniques like lab testing, a physical exam, a chest X-ray, an EKG, and a medical history. Despite all these tests, some study has questioned the accuracy of these traditional methods for diagnosing critically ill individuals (10).

Use of point-of-care ultrasonography has been expanding across a wide range of acute studied case management disciplines, involving acute onset dyspnea. PoCUS has been increasingly shown to be as accurate as the present imaging reference standard CXR, both generally and in conditions including pneumonia, acute decompensated heart failure, pleural effusion, pneumothorax, and pulmonary embolism. PoCUS has additional advantages, such as the capacity to be employed in real time at bedside & absence of ionising radiation. A wide range of unresolved diagnostic questions may be addressed by PoCUS, which can also help in optimising and customising therapy. However, just a few trials have examined important clinical findings linked to the use of PoCUS to date, & findings on outcome assessments have been mixed. However, just a few trials have examined important clinical results linked to the use of PoCUS to date, & findings on outcome assessments are uneven (11).

Because 20% of examined cases who present to emergency departments with dyspnea have inaccurate diagnoses, resulting in poor therapy, PoCUS may play a crucial diagnostic role in patient care. High-level evidence that this hypothesis is correct. In comparison to conventional modalities, PoCUS provides several advantages, including immediate results, the absence of ionising radiation, cost, reproducibility, independence from the patient's ability to hold their breath, mobility, and safety. Even though PoCUS usage has increased dramatically in critical care settings over the past 20 years, it has still been underutilised, as shown by the lower-than-expected prevalence of PoCUS devices in rural areas and the fact that only around 5% of ED cases with a study showed that PoCUS was used. Lack of standardised training facilities, operator dependency that makes it difficult to ensure quality, and, most importantly, a lack of excellent evidence-based recommendations for PoCUS may all contribute to this tendency (12).

Dyspnea has been 1 of the frequent alarming & disabling symptoms that researched subjects display in emergency rooms. According to several studies, the prevalence of cases of people who visit emergency rooms with breathing as their

main complaint ranges from 0.9 to 7.4 percent in different places, with a prevalence of 5 percent in Asia-Pacific region. Many conditions might make dyspnea their primary symptom. Early diagnosis is therefore crucial for these examined instances, along with appropriate therapy & ED discharge. Because of the subjectivity of symptoms, multiple overlapping clinical explanations for generating dyspnea, & comorbidities, accurate identification of these examined cases is difficult. Initial misdiagnoses may prolong hospital stays & have been related to higher mortality. Even though focused history & physical examination typically produce a correct diagnosis, in 30 to 50% of cases, additional diagnostic tests may be required. Chest radiographs are usually used to assess dyspneic study cases 1st, and sometimes further procedures like chest CT scans can be necessary later (13).

These methods subject researched patients to radiation exposure and have not been appropriate for pregnant examined cases. They depend on the resources of institutes and are only sometimes employed with cases that have not been thoroughly investigated. To determine studied cases and begin personalized therapy, the emergency department requires an early diagnostic tool. Ultrasonography has been employed in clinical settings as an imaging diagnostic technique for more than 50 years. However, due to outdated concepts of consultative ultrasonography and ultrasound's limited utility in the diagnosis of respiratory disorders due to occurrence of artifacts, its use in emergency rooms was restricted. Three new protocols—Bedside Ultrasound in Emergency protocol, Rapid Ultrasonography in Shock protocol, and Fluid Administration Limited by Lung Sonography protocol—are developed to firmly establish use of lung ultrasound in critically ill patients for diagnosis in a variety of situations like acute respiratory failure, undifferentiated hypotension, & guiding therapy like fluid treatment (14).

Emergency echocardiography performed by emergency physicians has been found to provide crucial information for examined instances of acute dyspnea with overall accuracy of 97.5 percent (4). Usage of ultrasound as a diagnostic tool in a range of clinical & specialist situations, such as lung ultrasound, emergency echocardiography, & IV Assessment, is being supported by growing data. Since speedy diagnosis in the ED is required, focused multi-dimensional ultrasound is being researched & used more frequently by emergency physicians. However, most of these studies have focused on identifying cardiovascular causes of acute dyspnea and exploring the potential of lung-cardiac-inferior vena cava integrated ultrasonography to differentiate primary pulmonary disease from acute heart failure syndromes in patients with acute dyspnea in emergencies (15).

It is still unclear how to distinguish between pulmonary and cardiovascular conditions as well as how to further divide up pulmonary disorders. The evaluation of analyzed cases who present with acute dyspnea in the ED using PoCUS has been investigated. However, as local illness incidence changes, the distribution of several differentials has changed. As a result, it might be possible to apply current literature equally in every circumstance. Additionally, ultrasonography methodology varies depending on the institutional procedure, producing varied results in several studies. Most frequent final composite diagnosis in the research population had been pneumonia. However, the most

common diagnostic and proportional distribution of differentials for acute dyspnea showed geographical variability. PoCUS's sensitivity and specificity were in line with previously written academic works. Sensitivity & specificity of the new studies were strikingly like those of the 2017 meta-analysis by Ling Long et al. (sensitivity 85.6 percent vs. 88 percent & specificity 87.7 percent vs. 88 percent). Comparable to the pooled data was positive likelihood ratio (6.99 vs. 5.37) & negative likelihood ratio (0.16 vs. 0.13) (16).

In recent investigations, PoCUS has a low negative predictive value (61.4 percent) & cannot rule out a diagnosis of pneumonia entirely. Next most frequent diagnosis was acute lung oedema (14.76 percent), and while this investigation's specificity was close to that of other research (97.7% vs. 98%), its sensitivity was lower (88.5% vs. 97%). Low sensitivity seen can be attributed to less exact acute pulmonary oedema diagnostic criteria in research & alternative diagnostic criteria in earlier studies. Moreover, there has been a learning curve to mastery as the research's investigators had only had 2 months of training as Emergency Medicine Residents. Transthoracic echocardiography had been added to PoCUS in the investigation to detect LV dysfunction (sensitivity 77.7 percent, specificity 96.9 percent), or ACS (sensitivity 50 percent, specificity 100 percent), which will further aid in determining the cause of acute pulmonary oedema and simplify patient management. PoCUS is a reliable 1st step in the diagnosis of acute pulmonary oedema because of its high negative predictive value of ninety-eight% (17).

Sensitivity & specificity for pleural effusion detection by the current study group had been higher than those in a current meta-analysis by Hansell et al., where CT scan served as the gold standard (sensitivity 100 percent vs. 91 percent & specificity 97.7 percent vs. 92%). The discrepancy between the two. Not all examined cases had CT scans in the ED to establish a diagnosis for ED disposition. was due to different gold standards. Because of PoCUS's extremely low positive predictive value of 76.1%, it may not be regarded as reliable initial technique for pleural effusion diagnosis. The substantial negative predictive value of one hundred percent obtained in our study, nevertheless, makes it useful tool for ruling out a diagnosis of pleural effusion. Based on lung ultrasound procedures used, sites evaluated for specified outcomes, ARDS diagnostic criteria, & gold standard used for comparison, the sensitivity of lung ultrasonography for the diagnosis of ARDS/ALI has varied. Sensitivity (28.5 percent) had been somewhat low, however, specificity (99.5 percent) had been excellent. This was due to the difficulty in performing simultaneous diagnosis of both illnesses with PoCUS due to the overlap of ultrasound features in pneumonia and ARDS/ALI. PoCUS has a positive predictive value of 90.9 & a negative predictive value of 88.9, making it useful diagnostic tool for ARDS/ALI diagnosis. In the early stages, it may be mistaken for pneumonia, and when it is present alongside pneumonia, it may be challenging to diagnose (11).

20% of investigated cases who present to the ED with dyspnea have inaccurate diagnoses, which results in inappropriate treatment. PoCUS can have a key diagnostic role in patient management. Strong argument for the validity of this hypothesis. PoCUS has a variety of advantages over conventional modalities, involving immediate findings, no ionizing radiation, cost, & reproducibility,

independence from the ability of examined subjects to hold their breath, portability, & safety. Although PoCUS use has grown dramatically in critical care settings over the past twenty years, it has been underutilized as seen by the lower-than-expected prevalence of PoCUS devices in rural areas & their use in only around 5% of ED examined cases. This trend may be explained in part by the lack of standardized training programs, operator dependency that makes it challenging to ensure quality, & most importantly—the scarcity of superior evidence-based recommendations for PoCUS. There has been evidence that PoCUS use should be promoted on national and international levels and that its application and use must be improved. Dyspnea is a frequent and frequently crippling symptom that has been described by painful, subjective breathing discomfort. In United States, about 1.2 million people sought treatment for dyspnea & respiratory issues at emergency rooms in 2016 (7).

Acute dyspnea's diagnostic work-up may be difficult. Particularly in individuals with recently developed dyspnea, a wide range of probable underlying diseases might result in complicated differential diagnosis. Studied cases with acute dyspnea should undergo thorough history taking, physical examination, blood test, electrocardiogram, & chest imaging as part of the standard diagnostic process. The phrase "point-of-care ultrasonography" refers to ultrasound that has been carried out by a treating clinician at the patient's bedside in real-time (as opposed to being recorded by technician & afterward interpreted by specialist). Ability of treating clinician to directly correlate POCUS examination results with the studied case's indications & symptoms allows for prompt patient care. POCUS may be used to improve bedside physical examinations since portable ultrasonography equipment & small, handheld imaging devices have grown more accessible & user-friendly during the past 10 years. Studies have demonstrated that when compared to conventional clinical examination, POCUS may enhance physician diagnostic ability. Additionally, POCUS does not demand transport of investigated cases to radiology suites & may be performed without risk of ionizing radiation exposure (3).

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