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VIEWPOINT

VOICES IN CARDIOLOGY

COVID-19 Front Line

Why Focused Lung and Cardiovascular Ultrasound?

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A precise and quick evaluation of patients with suspected coronavirus disease-2019 (COVID-19) is fundamental for risk stratification and proper decision-making process. Although the vast majority of the patients (81%) develop mild clinical manifestations, 19% of them could develop severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) requiring hospitalization and intensive care management (1). For this group, an improper evaluation could lead to a delay in the institution of medical support and, therefore, a higher probability for adverse outcomes.

Although the diagnosis of SARS-CoV2 infection is the mainstay for patient's categorization, the rapid antibody test starts to be reliable around 7 days after the onset of symptoms. Definitive SARS-CoV-2 diagnosis requires a positive reverse transcription polymerase chain reaction assay. Although reverse transcription polymerase chain reaction is considered highly specific in the first days of symptoms, it has a high false-negative rate. Nevertheless, it is not widely available, and the results usually take approximately 24 to 48 h to be processed. Therefore, the assessment of the pulmonary involvement could be an alternative screening method, and it could guide the clinician as to whether the patient needs admission to the hospital or intensive care unit or whether they could be discharged safely with an outpatient follow-up. Chest X-ray (CXR) is the most widely available imaging modality, but it has shown only a little benefit for the initial evaluation in nonemergency situations. In early stages, almost 60% of the COVID-19 patients have normal CXR images, and 90% have either normal or mildly abnormal CXR images despite the initial presentation with severe symptoms (2). The most frequent findings on CXR often appear around 10 to 12 days from symptom onset and are frequently described as bilateral lower patchy infiltrates or consolidations (2). Due to its higher sensitivity to detect the early degrees of pulmonary involvement, ground-glass opacification, patchy bilateral consolidations, or peripheral interstitial changes (found in 97% of patients with confirmed COVID-19), a chest computed tomography (CT) scan has been proposed as the gold standard imaging modality and has been incorporated in different triaging protocols (3,4). However, this approach also has several limitations; CT scan is not readily available in most limited-resource settings and it requires the patient's transport to the radiology department, which increases the risk of SARS-CoV-2 dissemination and staff exposure. Critically ill patients might also be too unwell to embark on a journey to the CT scanner.

Point-of-care ultrasound (POCUS) has been incorporated in emergency and intensive care practice and has been proposed as an extension of bedside physical examination to address compelling clinical questions so as to provide timely guidance in life-threatening situations. In COVID-19, POCUS overcomes some of the limitations of both CXR and CT scan. It can be performed by portable ultrasound devices, at the bedside, in limited-resource settings, or in triage zones outside the main clinical areas where traditional machines reside, therefore, it could reduce exposure of health care providers and avoid virulent particle transmission during transport to other areas (5). It is performed directly by the treating clinician, which allows a multisystemic integrated evaluation with instantaneous information.

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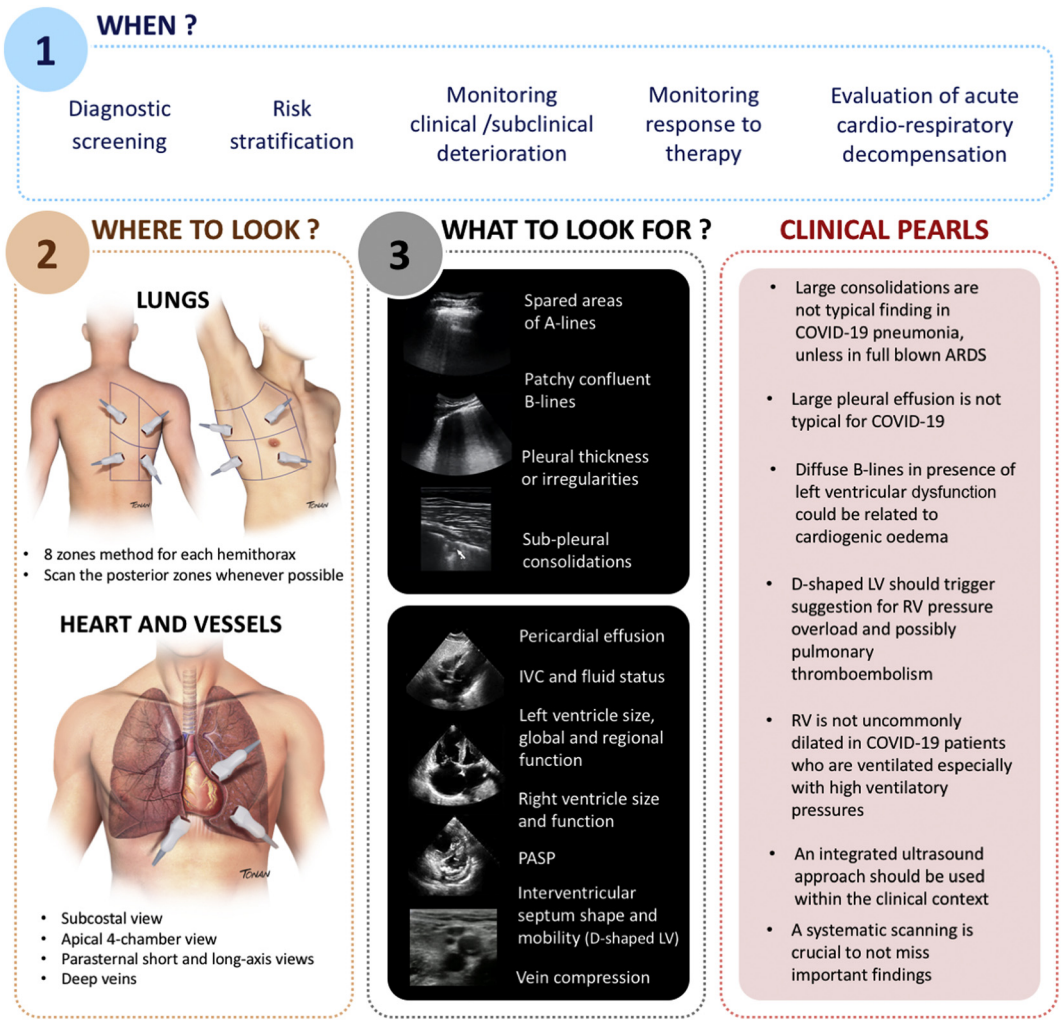
Moreover, ultrasound is free from ionizing radiation, which would enable one to safely repeat the examination whenever needed, reducing the use of CXR and CT scan and providing an additional useful monitoring tool (5). Therefore, focused lung and cardiovascular ultrasound examinations represent an appealing imaging approach that could be used to provide diagnosis and monitoring of patients with COVID-19.

Lung ultrasound (LUS) has a high sensitivity in detecting pleural and parenchymal abnormalities with a high negative predictive value. It enables the clinician to assess the degree of aeration/deaeration by monitoring the presence of normal aeration artifacts (A-lines, horizontal mirror-shaped reverberations of the pleural line) and abnormal reduced aeration artifacts (B-lines, vertical laser-like beams extending from the pleural line until the far-field and typically moving with pleural sliding). The loss of aeration will be represented by the lungs being transformed into a tissue-like structure (consolidation).

Because COVID-19 is a disease with peripheral lung distribution, LUS could provide a useful and accurate assessment of the peripheral abnormalities that are commonly encountered in those patients. The most

FIGURE 1 Focused Lung and Cardiovascular Ultrasound in COVID-19



ARDS = acute respiratory distress syndrome; COVID-19 = coronavirus disease-2019; IVC = inferior vena cava; LV = left ventricle; PASP = pulmonary artery systolic pressure; RV = right ventricle.

typical findings on LUS are as follows: 1) pleural thickening and irregularities; 2) subpleural consolidations; and 3) patchy areas of B-lines with areas of A-lines in between (spared areas) (**Figure 1**) (6). Those findings are not exclusive to COVID-19 because they could be found in patients with acute respiratory distress syndrome in general.

Cardiovascular ultrasound has become essential in management and stratification of patients with COVID-19. It was found to be useful to diagnose several cardiac abnormalities that could be seen in those patients. Right ventricular (RV) dilatation and dysfunction have been seen in many patients with COVID-19, which could be attributed to the requirement for positive pressure ventilation with high positive end-expiratory pressure, which increases RV afterload and, therefore, induces RV strain. The occurrence of venous thromboembolism in patients with COVID-19 has led to the discovery of a significant proportion of them having variable degrees of pulmonary thromboembolism, which could also lead to RV strain. Myocarditis also has been reported in patients with COVID-19 with 1 case report describing the presence of viral particles within the myocardium (7); however, there is no clear evidence that the viral particles directly invade the myocardium (8).

However, challenges exist in using POCUS in acute care settings; proper training and accreditation are essential. The implementation of POCUS data always should be done in the clinical context and as part of an integrated approach that incorporates clinical, laboratory, and imaging tools.

POCUS remains an ever-growing area in medicine, and its potential in transforming the way we treat our patients is huge, should we only use it properly and cautiously.

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