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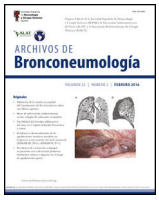

Editorial

When, Where, and How to Use Ultrasonography in Patients With Chronic Obstructive Pulmonar Disease☆

¿Cuándo, dónde y cómo utilizar la ecografía en pacientes con enfermedad pulmonar obstructiva crónica?

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Point-of-care ultrasonography is a diagnostic tool currently used by intensivists, emergency physicians, and pulmonologists. In COPD, ultrasonography has not been widely used because the acoustic window is believed to be unfavorable due to the large air content, particularly in patients with lung hyperinflation. However, there are different areas where ultrasonography may provide useful information for a complete clinical assessment of COPD patients in addition to classical lung function or radiological tests.

Assessment of Lung Parenchyma

Typically, the ultrasound pattern of lung in COPD is characterized by anterior-predominant bilateral A-lines with lung sliding and no consolidations. Sometimes there is substantially reduced or even abolished lung sliding, without evidence of lung point. Although direct signs of COPD pathology cannot be visualized by ultrasonography, the technique is sensitive to changes in lung parenchyma secondary to concomitant diseases or complications.

COPD and congestive heart failure are common in elderly populations and share common risk factors. Although it is known that they may coexist in a number of patients, in real life usually only one of them is diagnosed when both are present.[1] This is likely because the primary manifestations of both conditions are dyspnea and exercise intolerance. Lung function tests can differentiate between COPD and heart failure in the majority of cases, but in the presence of wet lung it may be difficult to evaluate the severity of COPD or to decide which coexisting disease is the major cause of dyspnea. A concomitant alveolar interstitial syndrome can be inferred from the presence of B-lines in lung ultrasonography images.[2] A more sensitive assessment of extravascular lung water was recently obtained in mechanically ventilated cardiac patients by quantitative analysis of lung ultrasonography.[3] The applicability of this method in patients with concomitant COPD and congestive heart failure needs to be investigated.

Pneumonia is a frequent complication in patients with COPD, but it is not always easy to distinguish it from a COPD exacerbation. Ultrasonography has shown an accuracy comparable with CT scans in the detection of lung consolidations due to community acquired pneumonia.[4] Thus, it may be a useful tool for differentiating pneumonias from COPD exacerbations, which needs further evaluation.

Assessment of Cardiac Function

Echocardiography is widely used by cardiologists for functional assessment of left and right ventricles and to estimate pulmonary vascular pressures. Pulmonary hypertension and right heart failure are well-recognized consequences of COPD, particularly in hypoxemic patients, and are predictors of hospitalization and mortality in these patients.[5] COPD severity is associated with significant changes in the volume of cardiac chambers, heart rate, and left ventricular filling properties,[6] adding weight to the hypothesis that altered lung mechanics has a negative impact on both right and left heart function. Several studies have demonstrated a correlation between COPD and cardiovascular fatal and non-fatal events.

There are several echocardiographic parameters that can give a more reliable assessment of right ventricle function than ejection fraction alone. The tricuspid annular plane systolic excursion (TAPSE) evaluates the distance traveled by the wall of the right ventricle, as defined by the plane of the tricuspid valve, during systole.[7] The Myocardial Performance Index (Tei index) is a measure of the time the right heart spends in isovolumetric contraction and isovolumetric relaxation relative to the time it spends actually pumping blood.[8] This method has been studied in pulmonary hypertension and has been found to have good prognostic potential.[8] Three-D echocardiography and tissue Doppler imaging have been developed to provide a more comprehensive picture of the pressure-volume relationship governing right heart function and to quantify the velocity of contraction and blood ejection. Two other echo indices

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have been proposed, the heart rate-adjusted pulmonary artery acceleration time (PAAcT) and the right ventricular systolic velocity (RVSmVTI). These are simple and reproducible methods that are well correlated with pulmonary artery pressure and pulmonary vascular resistance, and should be considered in the assessment of COPD patients with suspected pulmonary hypertension. They may also be of particular interest in patients with inadequate tricuspid Doppler signal.

A more recent technique is speckle-tracking echocardiography, which provides a representation of myocardial deformation during contraction. Both Doppler tissue imaging and speckle tracking can be used to estimate not only chamber anatomy but also a 2-D or 3-D strain pattern for the cardiac muscle. These dynamic measurements provide a more complete mechanical view of the right and left heart chambers, including estimation of pressure-volume relationships, and are currently under investigation for short-term monitoring and long-term prognostic values. In patients with severe COPD undergoing right heart catheterization, speckle-tracking echocardiography was very sensitive in identifying increased pulmonary vascular resistance.[9] In moderate-to-severe COPD with normal left ventricular ejection fraction, Schoos et al.[6] showed that left ventricular global longitudinal strain was the only independent predictor of all-cause long-term mortality. Decreased global longitudinal strain and impaired left ventricular mechanics were found to be associated with an increased BODE index in patients with COPD.[10]

Assessment of Diaphragm

In patients with severe COPD, the mechanical efficiency of inspiratory muscles is impaired, mainly because of lung hyperinflation, which makes the diaphragm less efficient due to its unfavorable position. This results in a reduced capacity to lower pleural pressure and reduced diaphragm excursion during inspiration.

M-mode ultrasonography has been widely used since the 1960s to assess diaphragmatic excursions, mainly in neuromuscular disorders. More recently, B-mode ultrasonography has been used to assess not only movement but also thickness and thickening of diaphragm during breathing movements.

A reduction of diaphragm mobility was found to correlate with dyspnea, degree of airflow obstruction, increase in residual volume, and CO_2 retention.[11] Although, neither diaphragm thickness nor contractility differ from normal in the majority of COPD subjects,[12] B-mode ultrasound may be useful in the non-invasive assessment of coexisting neuromuscular impairment and in the identification of high-risk patients prior to general anesthesia, mechanical ventilation, and weaning. More recently, the thickness of diaphragm assessed by ultrasonography was found to predict nocturnal desaturation in COPD patients with mild or no daytime hypoxemia.[13]

Conclusions

Ultrasonography is a rapid developing technique widely used in most fields. In patients with COPD it is still underused, but it may be a useful tool for assessing COPD exacerbations, pneumonias, heart-to-lung interactions, and diaphragmatic dysfunction. In comparison with other imaging techniques, ultrasonography has the advantages of being radiation-free, quick, repeatable, portable, widely available, and able to provide a bedside and real-time functional assessment.

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