CASE REPORT

Lung ultrasound may help in the differential diagnosis of suspected oligosymptomatic COVID-19 patients on hemodialysis: A case report

Marco Allinovi | Selene Laudicina | Lorenzo Dallari | Iacopo Gianassi | Egrina Dervishi | Maria Biagini | Lino Cirami

Nephrology, Dialysis and Transplantation Unit, Careggi University Hospital, Florence, Italy

Correspondence
Marco Allinovi, Nephrology, Dialysis and Transplantation Unit, Careggi University Hospital, Largo Brambilla 3, 50134 Florence, Italy.
Email: marco.allinovi@gmail.com

Abstract

Introduction: Considering that patients on dialysis showed a poor outcome during COVID-19 pandemic, and that COVID-19 symptoms in dialysis patients are often mild or absent, each dialysis unit should implement local strategies to early recognize patients affected by COVID-19. However, many available SARS-CoV-2 diagnostic tests demonstrated a moderate sensitivity, 70%–80% is probably a reasonable estimate. Consequently, having useful tools for differential diagnosis becomes essential. In this scenario, lung ultrasound (LUS) may have an important role in the evaluation of lung involvement in hemodialysis patients during COVID-19 pandemic.

Methods: We present two cases of hemodialysis patients with COVID-19 pneumonia in whom LUS had a central role in the diagnostic process. Ultrasound images of COVID-19 pneumonia show a typical bilateral pattern characterized by multiple or confluent B-lines with spared areas, thickened and irregular pleural line, and rare subpleural consolidations. LUS showed high accuracy in diagnosing COVID-19 pneumonia.

Findings: Despite both patients appeared clinically euvoelemic and afebrile, they presented with acute diarrhea and oxygen saturation level of 92%–93%. Although clinical manifestations were mild and not specific in both patients, LUS raised suspicion on the possible COVID-19 diagnosis which was confirmed by a positive nasopharyngeal RT-PCR.

Discussion: There are many reasons for a patient on dialysis to present shortness of breath, fever, and multiple B-lines at LUS assessment (such as heart failure, fluid overload, vascular access infection, interstitial pneumonia) but the recognition of typical ultrasound patterns of the COVID-19 pneumonia is helpful for differential diagnosis. LUS may have an important role in the screening process of hemodialysis patients during the COVID-19 pandemic, especially in oligosymptomatic patients before the SARS-CoV-2 diagnostic tests, and in those with suspected symptoms and/or known exposure with unexpected negative SARS-CoV-2 diagnostic tests.
**INTRODUCTION**

During COVID-19 pandemic, each dialysis unit should implement local strategies to early recognize patients affected by COVID-19. Considering that dialysis patients affected by COVID-19 showed a poor outcome, COVID-19 symptoms in dialysis patients are often mild or absent, and even asymptomatic patients can spread the virus, it would be mandatory to test and screen dialysis patients periodically. This is particularly true considering that the incidence of fever, symptomatic pulmonary congestion, and dyspnea has always been reported high in hemodialysis population, all aspects resembling COVID-19 typical symptoms.

However, many available SARS-CoV-2 diagnostic tests (e.g., nasopharyngeal RT-PCR) demonstrated a high specificity but a lower sensitivity, 70%–80% is probably a reasonable estimate. Consequently, clinicians should not trust unexpected negative results (i.e., assume a negative result is a “false negative” in a person with suspected symptoms and/or known exposure). During an ongoing outbreak, when timely access to sensitive and rapid (<30 min) molecular testing is unavailable, having useful tools for differential diagnosis becomes essential.

**FIGURE 1** A proposed flow-chart on the management of hemodialysis patients to control COVID-19 in dialysis centers
In this scenario, lung ultrasound (LUS) may have an important role in the evaluation of lung involvement in hemodialysis patients during COVID-19 pandemic (Figure 1). For nephrologists, LUS is a validated technique to detect pulmonary congestion and estimate fluid status. In presence of lung congestion, the thickened interlobular septa generates a hyperechoic ringdown artifact called B-line (Figure 2). The specificity of B-lines and subpleural consolidations is low for COVID-19 diagnosis as they appear in many different conditions. For example, B-lines can be visualized in any disease process causing interstitial lung disease (such as mild to moderate lung congestion, pulmonary edema, interstitial pneumonitis, viral pneumonia, pulmonary fibrosis, ARDS).

Ultrasound images of COVID-19 pneumonia show a typical bilateral pattern characterized by multiple or confluent B-lines with spared areas, thickened and irregular pleural line, and rare subpleural consolidations (Figure 3). LUS showed high accuracy in suspecting COVID-19 pneumonia and, compared with chest CT scan, has many advantages: no use of ionizing radiation, bedside technique (therefore no need to move the patient), and easy sterilization.

**FIGURE 2** Ultrasonographic features of lung ultrasound in a hemodialysis patient with mild hypervolemia: (a) normal sonographic lung appearance with the pleural line (hyperechoic horizontal line) and multiple horizontal reverberations of the pleural line (A-lines); (b) short reverberation artifact which start from the pleural line and move with lung sliding, but its appearance is obviously different from B-lines (white arrow); (c) a single comet-shaped B-line, with a triple line converging in a single point on the pleural line, considered as a single B-line (white arrow); (d) two single thin B-lines (white arrows)

**FIGURE 3** Ultrasonographic features of COVID-19 pneumonia: (a) a subpleural consolidation (yellow asterisk); (b) irregular pleural line (green arrow) with multiple blurred B-lines (yellow asterisks)
We present two cases of hemodialysis patients with COVID-19 pneumonia in whom LUS had a central role in the diagnostic process.

**CASE REPORT**

The first case was an 82-year-old woman on chronic hemodialysis who presented with severe diarrhea, shortness of breath, oxygen saturation level 93%, and increased level of C-reactive protein. Despite the patient appeared clinically euvoletic and afebrile, LUS showed a thickened pleural line, along with diffused, bilateral, and asymmetric B-lines, especially at the lung bases. Shortness of breath and B-line pattern did not improve with ultrafiltration after the dialysis.

The second case was a 60-year-old man diagnosed with AL amyloidosis and cardiac involvement, hospitalized for fluid overload and worsening of kidney function which required dialysis treatment. During recovery, he had direct contact with a COVID-19 patient, however, he remained afebrile and oligosymptomatic, and has been weaned from oxygen therapy, with stable oxygen saturation level 92%. He developed acute diarrhea in the hospital, with negative direct fecal cytotoxic tests for *Clostridium difficile* toxins. The bedside LUS showed several confluent B-lines with spared areas, thickened and irregular pleural line, bilateral pleural effusion and several subpleural consolidations. B-line pattern did not change with ultrafiltration after the dialysis.

Although clinical manifestations were mild and not specific in both patients, LUS raised suspicion on the possible COVID-19 diagnosis. Both patients were diagnosed by COVID-19 after the LUS assessment, confirmed by a positive nasopharyngeal RT-PCR.

**DISCUSSION**

During COVID-19 pandemic, each patient should undergo a predialysis triage, consisting of the assessment of body temperature and individuation of symptoms or signs suggestive for COVID-19 (such as fever, dyspnea, shortness of breath, cough, sore throat, myalgia, diarrhea, and anosmia) (Figure 1). Suspected patients should be moved to a dedicated room in order to complete clinical evaluation, and eventually a LUS assessment, by a physician provided with appropriate personal protective equipment.

There are many reasons for a patient on dialysis to present dyspnea, fever or multiple B-lines at LUS assessment (such as heart failure, fluid overload, vascular access infection, interstitial pneumonia). However, the following aspects are helpful for differential diagnosis: (a) the recognition of typical ultrasound patterns of the COVID-19 pneumonia, (b) the discrepancy between the number of B-lines and the expected number in relation to the dry weight prescribed clinically, and (c) stable number of B-lines even after a strong ultrafiltration.

Although the use of LUS in dialysis has grown rapidly and is widely recommended as a technique for monitoring patients’ dry weight in order to personalize dialysis therapy both in adults and in children, by the time, only one case report has been published on the role of LUS in diagnosing or suspecting COVID-19 in patients on dialysis. Even in patients on dialysis, the use of LUS allows to integrate the information about LUS patterns with all the information obtained from medical history, clinical examination and blood exams, helping decision-making process. LUS may have an important role in the evaluation of lung involvement in hemodialysis patients during the COVID-19 pandemic, especially in oligosymptomatic patients. In this setting, LUS may be a first-line diagnostic imaging alternative to chest CT scan early in the course of COVID-19 disease, even before overt clinical manifestations. Moreover, LUS may have an important role in the evaluation of those oligosymptomatic patients with a first negative SARS-CoV-2 diagnostic test result. These patients should be moved to a dedicated room, in order to undergo dialysis in an isolated room, and perform a complete LUS evaluation of the chest, and eventually repeat nasopharyngeal RT-PCR. Considering the imperfect diagnostic accuracy of SARS-CoV-2 diagnostic tests, when clinical, sonographic, laboratory, or imaging evaluations were suspicious of SARS-CoV-2 infection, those patients who tested negative at the first nasopharyngeal RT-PCR should repeat a second RT-PCR, either on nasopharyngeal swab or bronchoalveolar lavage. In fact, an asymptomatic or oligosymptomatic form of SARS-CoV-2 infection is common in hemodialysis patients, especially among patients with initial negative PCR that later seroconvert.

LUS may help to screen and early diagnose COVID-19 pneumonia in different settings, particularly in areas with high rates of community transmission. We would propose to expand this approach to different settings characterized by frequent contact with healthcare facilities and other patients, and high comorbidity burden (such as emergency departments, hemodialysis centers, nursing homes, transplant outpatients clinic). In a recent study, the integrated clinical-LUS assessment correctly identified those patients who tested negative at the first nasopharyngeal RT-PCR but resulted positive at a subsequent molecular test performed within 72 h.

We propose that dialysis units adopt LUS in daily clinical practice as a bedside tool not only for fluid status...
assessment and dry weight prescription, but also for improving the differential diagnosis of fever and dyspnea in suspected COVID-19 patients on hemodialysis (Figure 1).

CONFlict of interest
The authors have declared that no conflict of interest exists.

AuThOR CONTRIBUTIONS
Selene Laudicina, Lorenzo Dallari, Iacopo Gianassi, Egrina Dervishi, Maria Biagini, Lino Cirami, and Marco Allinovi helped in the concept and design, literature review and preparation of the manuscript.

ETHICS STATEMENT
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee at which the studies were conducted and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The Ethics Committee approval has been obtained.

Informed consent to participate and for publication was obtained from all individual participants included in the study.

ORCID
Marco Allinovi https://orcid.org/0000-0001-9949-3543

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