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CASE SERIES IN OCCUPATIONAL HEALTH

Lung ultrasound for monitoring COVID-19 disease in healthcare workers: Less stethoscope and more ultrasound in occupational health

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Abstract

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is causing the new global pandemic and is responsible for numerous cases of severe pneumonia. Recent evidence has indicated the usefulness of lung ultrasound (LUS) in detecting SARS-CoV-2 pneumonia. LUS has several advantages, and in the context of COVID-19 pandemic, point-of-care LUS is particularly useful when the infected subject is forced to complete quarantine at home or patient's conditions can be monitored only on a clinical basis. In addition, bed approach can also rationalise access to the emergency department only to those who really need hospitalization, reducing the economic burden of the pandemics on healthcare systems. In this paper, we present a case series of healthcare workers with SARS-CoV-2 infection, monitored at home by their occupational physician with point-of-care LUS. According to our experience, this tool can be included in mandatory occupational health surveillance as well as in workplace health promotion programs for monitoring the health of healthcare workers affected by COVID-19 disease and facilitate their return to work.

KEY WORDS: COVID-19; point-of-care test; SARS-CoV-2; ultrasound imaging.

INTRODUCTION

Since December 2019, a novel pathogen called SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) has spread all over the world. The severity of COVID-19, which is the pathology caused by SARS-CoV-2, varies from asymptomatic/paucisymptomatic patients, who do not need hospitalization, to patients with acute respiratory failure who need oxygen therapy. It is estimated that between 5-32% of patients are hospitalized in intensive care unit and need mechanical ventilation [1, 2]. Impact of COVID-19 outbreak on healthcare workers (HCWs) in Italy and the rest of the world is huge and may have negative consequences on healthcare systems [3].

The high number of hospitalized patients has generated a health emergency for many countries worldwide and has created the need for monitoring many infected people even at home. The imaging presentation of COVID-19 pneumonia on computed tomography (CT) is of patchy ground glass opacities in the peripheral lung parenchyma with partial consolidations, while the ultrasound expressions are white lung areas and confluent vertical artefacts [4, 5]. Considering that lesions from COVID-19 develop from the periphery to the center, lung ultrasound (LUS) can be an excellent tool for monitoring patients with a diagnosis of COVID-19 in pre-hospital management and allowing their follow-up throughout the evolution of the disease, as pointed out by some researchers [6, 7]. Furthermore, Biasucci and colleagues have recently proved that LUS is a useful tool for bedside stratifying patient's severity thanks to an early identification of patients who need hospitalization for mechanical ventilation [8]. In our study, we reported three cases of HCWs suffering from SARS-CoV-2 infection, who were monitored at home during the second wave of COVID-19 pandemic in Italy by their occupational physician through point-of-care LUS.

TAKE-HOME MESSAGE

Notably, lung ultrasound can easily detect SARS-CoV-2 pneumonia. This case series highlights that it can be a useful and cost-effective tool for the management of infected workers by occupational physicians thanks to its portability at the bedside during home isolation.

Competing interests - none declared.

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METHODS

Point-of care LUS in the management of infected workers

As with other infectious diseases, early detection, isolation of the infected patient, and contact tracing activity are essential to reduce the spread of the pathogen even within the hospital [9], as well as vaccination [10]. For this reason, since the beginning of COVID-19 epidemic in Italy, the Occupational Medicine Unit and the Health Directorate of the Bambino Gesù Children's Hospital (Rome) have operated to promptly detect infection-positive HCWs according to a specific internal protocol of COVID-19 case confinement and management. The diagnosis of SARS-CoV-2 infection is detected using molecular tests searching for the virus RNA (through Real-Time polymerase chain reaction) on a nasopharyngeal swab. Regular checks have been performed on all workers during contact tracing activity at zero time, and after 5 and 10 days, as well as routinely every 15 days in workers employed at high-risk departments. In case of positive result of PCR testing, isolation was mandatory. During the isolation period, the worker's health status was regularly checked through peripheral blood tests and serial nasopharyngeal tests at home until the samples turned negative. Phone active surveillance was performed by the occupational physician, too. Since April 2020, a point-of-care LUS was implemented by the Occupational Medicine Unit as a specific prevention measure to monitor the progression of lung disease in patients admitted in our Department and after hospital discharge. Each HCWs reporting chest pain during the screening testing activity was subjected to LUS at home by the occupational physician. LUS examination was performed using an ultrasound pocket device (Sonosite iViz model) with a convex or linear probe, according to the anthropometric characteristics of the patient, and ultrasound transmission gel in single use package [11]. Before each use, the ultrasound was covered with transparent plastic disposable material to avoid contamination (Figure 1). LUS was performed in patients in the sitting position and for the analysis each hemithorax was divided into 7 parts (3 posterior, 2 lateral, and 2 anterior).

Ethical aspects

Informed consent was obtained by all subjects for the publication of their medical records. The study was approved by the Health Di-

Figure 1. Ultrasound pocket device covered with transparent plastic disposable material.

rectorate of the Bambino Gesù Children's Hospital (Rome) and conducted in the framework of the mandatory occupational health surveillance conducted in compliance with Italian law (Legislative Decree no° 81/2008).

CASE PRESENTATION

Case 1

A previously healthy 55-year-old female nurse underwent a nasopharyngeal swab by occupational physician, because five days earlier, she had been in contact with a person outside the hospital who was later diagnosed with COVID-19. She tested positive. At the time of diagnosis and for the next 3 days the patient had cough, anosmia, asthenia and dysgeusia but she did not have fever. On the fourth day, the patient reported slight shortness of breath during physical effort despite a normal oxygen saturation (SaO_2 = 97% in ambient air, a.a.). LUS showed few bilaterally isolated B lines without consolidations, areas of white lung or pleural effusion (Figure 2A). Subsequently, the patient maintained good general condition, eupnoea, and a normal SaO_2. The entire course of the illness was carried out at home in isolation. SARS-CoV-2 genes were no longer detected at the control swab after 10 days.

Case 2

A 51-year-old female physician with well-controlled asthma (in therapy with beta$_2$-agonist in case of acute asthma attack) employed at the Emergency Department of our hospital, was subjected for routine SARS-CoV-2 surveillance, with nasopharyngeal swabs performed by our occupational health service every 15 days. At the time of diagnosis of the viral infection, the patient was asymptomatic, but 48 hours after symptoms onset, she developed headache, anosmia, dysgeusia, asthenia, and fever. After 24 hours a dry cough with a SaO_2 of 98% in a.a. appeared.

In the following days, the clinical picture worsened as the patient had a SaO_2 of 94% in a.a. at rest and a further reduction up to 90% in a.a. at the walking test. The LUS performed at home showed a normal pleural sliding with diffused and confluent B lines bilaterally placed (anteriorly at the basal portion and posteriorly at the apical and middle portion). There were also areas of white lung in the basal region bilaterally, so she was sent to hospital to be admitted.

During the 13-day hospitalization, the patient carried out oxygen therapy also at high flow in association with oral azithromycin, intravenous cortisone, and heparin subcutaneously. After 10 days from the discharge, new LUS was performed at home with confirmation of B lines bilaterally spread in the basal region and sparse single B lines in the other quadrants; white lung was disappeared and SaO_2 risen to 98% in a.a. A third LUS, performed 26 days after the first one, showed normal pleural sliding without consolidation nor pleural effusion (Figure 2B). A negative nasopharyngeal swab was evident after 53 days.

Case 3

A 33-year-old male physician underwent nasopharyngeal swab, because he was a close contact of a confirmed COVID-19 case. Personal anamnesis showed only diaphragmatic hernia treated at birth and atopic rhinitis (allergy to dust mites) in therapy with oral antihistamine. When the physician was subjected to swab test, he was still asymptomatic. One day after the swab, he developed gastroenteritis, asthenia, and muscle pain for the following 5 days. After the next 3 days, he had dry cough with a normal SaO_2 at rest and during walking test (98% in a.a.). As the patient reported chest pain during respiratory acts, LUS was performed at home. Normal pleural sliding and no pleural effusion were highlighted, but a small area of white lung in basal region without consolidation was bilaterally evidenced. During the isolation period he did not presented fever, dysgeusia or anosmia, and cardiorespiratory parameters have always been normal. After 26 days, the control nasopharyngeal swab was negative and LUS showed normal pleural sliding without B lines nor pleural effusion.

DISCUSSION

In this paper, we have described three cases of HCWs, two females and one male, with SARS-CoV-2 infection, and an innovative occupational health surveillance program conducted during the second wave of COVID-19 pandemic in Italy. To our knowledge, there are no other centres in Italy where the occupational physician performs LUS examination at workers' home.

In case of COVID-19 pulmonary involvement, lesions are mainly evident in the peripheral area, which can be easily studied through ultrasonography [12, 13]. For this reason, as highlighted by Musolino et al, our case series confirm that LUS may be useful not only in the diagnosis but also in the follow-up of COVID-19 patients [14].

Although RT-PCR has been routinely used to confirm COVID-19 diagnosis, false negative RT-PCR tests may occur [15, 16]. Chest CT remains the gold standard technique, but it is expensive [17]. Conversely, LUS has several advantages: it can be run at the bedside (even at home) with a consequent reduction in the risk of SARS-CoV-2 transmission [18]; it does not expose the patient to ionizing radiation [19] or to magnetic fields [20]; it does not require long training and can be performed by a single operator; it is a low-cost imaging test [21]. Point-of-care LUS is particularly useful when the infected subject is forced to complete quarantine at home for a long period of time, or patient's conditions can be monitored only on a clinical basis. In addition, bed approach can also rationalise access to the emergency department only to those who really need hospitalization, reducing the economic burden of the pandemics on healthcare systems.

In recent years, ultrasound has been increasingly used for diagnosis in many fields [21]. Portable devices have shown a great potentiality as a screening tool, especially for life-threatening or disabling diseases in low- and middle-income countries, where hand-held ultrasound devices represent a virtuous strategy [22]. Emerging consensus is focusing on ultrasound utility in conjunction with the traditional stethoscope to be taught in medical education and practice [23]. Beyond its undiscussed value in surgery and emergency [21], ultrasound has been applied in the context of body composition characterization [24], and has recently marked a turning point for the acute management of COVID-19 patients [25]. To this respect, our experience testifies the validity of LUS for the management of workers who need to stay at home for COVID-19, because this strategy may safeguard HCWs operating at the frontline as well as the entire healthcare system.

From an occupational health viewpoint, ultrasound could represent an effective screening method for an in-depth fast investigation of suspectedly impaired organs (after stethoscope auscultation) during the mandatory surveillance visit. In addition, ultrasound could represent an important step in the framework of workplace health promotion (WHP) programs for improving workers' quality of life. In Italy, occupational physicians are requested taking care workers affected by severe forms of COVID-19 before returning to work [26, 27]. Therefore, a screening ultrasound check for COVID-re-

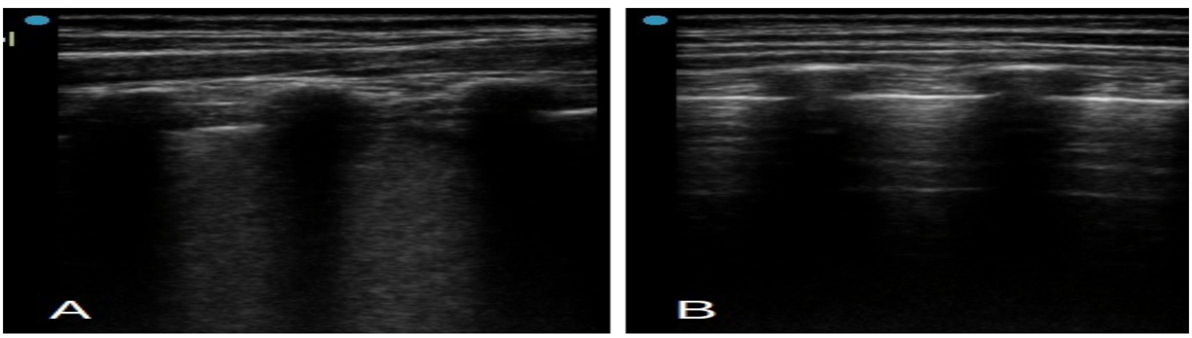

Figure 2. Lung ultrasound at time 0 (2A) and after 26 days (2B) of case 2.

lated sequelae and post-COVID-19 syndrome may be a useful and innovative approach for occupational health surveillance and WHP programs [28].

CONCLUSION

This case series highlights the importance of LUS in the evaluation and monitoring of COVID-19 patients as well as for HCWs affected by COVID-19. LUS is a useful, effective and cost-saving tool for occupational physicians, and may open new horizons for cutting-edge approaches in occupational health.

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