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Mini Review

The role of mobile handheld lung ultrasound in the diagnosis and monitoring of COVID-19 atypical pneumonia

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Abstract

Background: Our aim is to present the importance of mobile Handheld Lung Ultrasound (HLUS) in COVID-19 patients at the bedside, which is a pre-screening tool with high diagnostic value that can provide triage of symptomatic patients at home (pre-hospital), emergency services, Intensive Care Units (ICU). In this context, the current role and importance of HLUS at the bedside in COVID-19 pneumonia has been summarized.

Method: We searched pubmed with key words; COVID-19 pneumonia, Lung Ultrasound (LUS), handheld ultrasound and reached 2428 articles with full texts. All abstracts were searched and 470 systematic review and meta-analysis determined. Only 10 articles were directly related to COVID-19 pneumonia and HLUS. These articles were interpreted to determine the role of HLUS at the bedside in COVID-19 pneumonia.

Results: Although not specific for COVID-19, Ultrasonography (US) findings of peripheral interstitial viral pneumonias due to COVID-19 lung involvement are very characteristic. The use of HLUS in COVID-19 atypical pneumonia is of critical importance due to its high diagnostic value in diagnosis and follow-up. It was shown that the sensitivity and specificity of bedside LUS in the diagnosis of atypical pneumonia were high enough to include in radiologic algorithm.

Conclusions: Handheld pocket-sized US devices are cheap, easy to handle and equivalent to standard scanners for non-invasive assessment of severity and dynamic observation of lung lesions in COVID-19 patients with pneumonia. So it has become of great importance to make a useful and simple radiological algorithmic approach that includes bedside HLUS in the diagnosis and follow-up of COVID-19 pneumonia patients.

Abbreviations

US: Ultrasonography; LUS: Lung Ultrasound; HLUS: Handheld Lung Ultrasound; CT: Computed Tomography; DR: Digital Radiography

Introduction

The basic structural problems of the health system in the world have emerged as a result of the COVID-19 pandemic. Basically, the problem seems to be investing heavily in curative health services instead of preventive and primary health care services. Of course, in this process, radiological imaging methods naturally take their share from the reflections of the problem. US, which has been used rapidly all over the world since the 1970s, has a special place among all imaging modalities in terms of being relatively harmless, inexpensive, reproducible, easily accessible and fast results. Its general disadvantages are that ultrasonic waves cannot physically pass through air or bone, and relatively user-dependent, labor-intensive. Recently, the disadvantage of user dependency has been eliminated since video recordings can be taken and stored during the examination and remote consultation with Telemedicine [1]. As a clinical advantage, unlike other imaging methods, it requires close contact between the practitioner and the patient.

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LUS is rarely done in routine radiology practice except for some emergency pathologies. This situation prevented radiologists from having sufficient experience in US findings of peripheral lung infections. It is a natural process that the physicians who undertake the treatment of the patient, using US as a diagnosis and treatment monitoring method. Nowadays, with the widespread use of US, experience and knowledge of clinicians, lung examination with handheld US devices has now replaced the stethoscope as an evidence-based imaging method [2]. These mobile US devices are pocket-sized, light and affordable. Convex probe 5-7 MHz is preferred mainly. Linear probes are only preferrable to study the detail of the pleural and subpleural alterations [3,4].

Handheld US has been used very effectively at the bedside in home care services, outpatient clinics, emergency units, and intensive care units by Radiologists, Emergency physicians, Family physicians, Pediatricians, Cardiologists, Pulmonologists and Intensive Care physicians in all over the world [5]. Thus, the same and one clinician will be required to conduct an objective medical examination and imaging directly bedside [2,5]. Since it is difficult to predict how much the pandemic will force the imaging units, it has become of great importance to make a radiological algorithmic approach that includes bedside HLUS in the diagnosis and follow-up of COVID-19 patients.

Results

LUS at the bedside has been widely used in COVID-19 pneumonia in Italy, one of the countries most affected by the pandemic [4,6]. Although not specific for COVID-19, US findings of peripheral interstitial viral pneumonias due to COVID-19 lung involvement are very characteristic. The characteristic sonographic pattern of multifocal confluent B-lines with irregular pleural markings was seen on LUS in patients with COVID-19 pneumonia [7,8]. It was shown that the sensitivity and specificity of bedside LUS in the diagnosis of atypical pneumonia were high enough to include in radiologic algorithm. The use of HLUS in COVID-19 atypical pneumonia is of critical importance due to its high diagnostic value in diagnosis and follow-up [8,9].

Discussion

Almost all scientific articles about LUS of COVID-19 pneumonia originating from Italy and China have been made in cooperation with Emergency physicians, Pulmonologists and Intensive care physicians. A big image database allowed COVID-19 LUS diagnostic scoring creation in this period [6]. Sonographic pattern of multifocal confluent B-lines with irregular pleural markings was seen on LUS in patients with COVID-19 pneumonia. The accuracy of these findings showed a high sensitivity (91%) and specificity (86%) for COVID-19 pneumonia [8].

In another study with totally of 127 patients, it was shown that the sensitivity and specificity of bedside lung US in the diagnosis of atypical pneumonia were 98.0% and 95.8%, respectively. In these cases where consolidation was not determined in LUS but B-3 line positivity or a diffuse interstitial pattern was present, the sensitivity and specificity were 93.3% and 88.2%, respectively. This study showed that when consolidation was not observed in LUS, the presence of B-3 line positivity or diffuse interstitial pattern could be used for the diagnosis of pneumonia [9].

The current clinical evidence and LUS findings of similar aspects in other pathologies (flu virus pneumonia, Acute Respiratory Distress Syndrome) strongly suggest a potential diagnostic accuracy of bedside LUS examination in COVID-19 pandemic may be useful for; triage (pneumonia / non-pneumonia) of symptomatic patients at home as well as in the pre-hospital phase, diagnostic suspicion and awareness in the Emergency Room setting, prognostic stratification and monitoring of subjects with pneumonia on the basis of the extension of specific patterns and their evolution towards the consolidation phase in the Emergency Room setting, management of ICU patients with regard to ventilation and weaning, monitoring the effect of therapeutic measures and reducing the number of healthcare professionals exposed during patient stratification.

Conclusions

As a result, we can suggest a simple algorithm of HLUS at the bedside in the COVID-19 pandemic concerning these articles. Except for pregnant patients, before mobile LUS examination, first DR (Digital Radiography) should be done algorithmically. After detecting a peripheral lesion in the patient with chest radiography, LUS examination indication arises. In addition, at the first arrival of patients with COVID-19 pneumonia, the characteristic peripheral localization of the lesions in Lung CT (Computed Tomography) enables the decision of the follow-up of these patients with LUS at the bedside. Meanwhile the patient's clinical status and clinical course, resource constraints of the hospital, the quantity and quality of the LUS practitinors should be considered too.

After all, we cannot predict how much the COVID-19 pandemic will strain our health system in these pandemic times. Handheld pocket-sized US devices are cheap, easy to handle and equivalent to standard scanners for non-invasive assessment of severity and dynamic observation of lung lesions in COVID-19 patients with pneumonia [10]. Also HLUS can be used at the bedside, especially in emergency units, intensive care patients, children and pregnant women, can be performed by a single clinician, and can be repeated safely because it does not contain X-rays. The use of HLUS is of critical importance due to the reduction of burden in hospital care, CT units and the risk of transmission, and its high diagnostic value in diagnosis and follow-up [8,9].

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