Lung Ultrasound in Children With COVID-19

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Abbreviations:
LUS: Lung ultrasound
COVID-19: Coronavirus Disease 2019

Dr Denina conceptualized and designed the study, performed lung ultrasound examinations, drafted the initial manuscript, and revised the manuscript.
Drs Scolfaro, Pruccoli, Zoppo and Mignone, collected data, carried out the initial analyses, and reviewed and revised the manuscript.
Prof Ramenghi, Drs Garazzino and Silvestro supervised data collection, and critically reviewed the manuscript.
All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Introduction

The novel Coronavirus Disease 2019 (COVID-19) is rapidly spreading all around the world, affecting both adults and children. Recently, the clinical and radiographic characteristics of infected children have been described[1]. Even though lung ultrasound (LUS) is recognized as a valid imaging technique for the diagnosis and follow-up of pneumonia in children[2], no data are currently available about LUS use in COVID-19 affected children. Considering the well-known advantages of point-of-care ultrasound[3], including the possibility of reducing the patient's movement across the hospital department, we investigated LUS findings in children infected with Sars-Cov2.

Methods

We performed an observational study at Regina Margherita Children Hospital (Turin, Italy). Children and adolescents (0-17 years) admitted to the pediatric infectious diseases department for documented COVID-19 were analyzed. Epidemiological, clinical, and laboratory data were collected, and we categorized patients according to the clinical definitions recently provided by Qiu et al[1]. LUS was performed during the routine medical examination, with a linear array transducer at 7.5 to 13 MHz (MyLab™Seven; Esaote) applying the Copetti protocol[4].

Results

Between March 18 and March 26, 2020, eight children affected by COVID-19 were admitted to our department. Epidemiological and clinical features are provided in table 1. Two patients (25%) were classified as severe clinical types, two (25%) as moderate, and four (50%) as mild. Two (25%) children needed non-invasive oxygen administration for 2 and 4 days, respectively. None of them required mechanical ventilation. We performed LUS in all eight patients, paying particular attention to signs of viral pneumonia as small subpleural consolidations and/or individual B-lines or confluent B-lines (echogenic vertical lines arising from the pleural line and moving in concert with a sliding lung, expression of an interstitial syndrome)[5]. LUS documented subpleural consolidations in 2 children and confluent B-lines in 5. In 7/8 cases, we found a concordance with the radiologic findings (figure 1), whilst in the remaining patient, an interstitial B-lines pattern was observed despite a normal chest radiography. One patient with severe clinical type was repeatedly examined with LUS on alternate days, and we noted a B-lines bilateral pattern reduction a day in advance before clinical and radiographic improvement.

In the seven children with pathologic ultrasound imaging at baseline, LUS was repeated before discharge, showing improvement or resolution of consolidations (2/2) and interstitial patterns (5/5), consistent with the concomitant radiologic findings.

Conclusion

Investigators have shown that in adults with COVID-19 pneumonia, bedside US correlates with CT findings[6]. Our study represents a preliminary report of lung ultrasound characteristics in children affected by COVID-19. While the number of patients analyzed is small, the high concordance between radiologic and LUS findings suggests that ultrasound may be a reasonable method to detect lung abnormalities in children with COVID-19. LUS may be useful in the management of children with COVID-19 for several reasons. First, it may reduce the number of radiologic examinations, lowering the radiation exposure of the patients. Secondly, being performed at the bedside, it allows to reduce the patient's movement within the hospital, thus lowering the number of health-care workers and medical devices exposed to Sars-Cov2. Moreover, the recent evolution in the ultrasound field allows the use of wireless devices, which, when available, are probably the most appropriate ultrasound equipment in patients with confirmed or suspected COVID-19. Both the wireless probe and the tablets are easily wrapped in disposable plastic covers, allowing simple sterilization procedures and reducing the risk of contamination, as recently suggested by Buonsenso et al[7].

In conclusion, although further studies are needed to better understand and characterize LUS findings in this novel disease in children, we propose LUS routinely protocol examinations as a useful tool in the diagnostic and clinical management of mild/severe Covid19 in children.

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Table 1: Epidemiological and clinical features of COVID-19 pediatric patients stratified by clinical types.

	Total (n=8)	Severe cases (n=2)	Mild cases (n=2)	Moderate cases (n=4)
Epidemiological data				
Female patients	3 (37.5%)	1 (50%)	1 (50%)	1 (25%)
Male patients	5 (62.5%)	1 (50%)	1 (50%)	3 (75%)
Age, years (SD, range)	4.2 (0.2-10)	3.9 (3.9 – 4)	5.1 (0.2-10)	3.8 (0.5 – 7.2)
Family members with COVID19	8 (100%)	2 (100%)	2 (100%)	4 (100%)
Symptoms				
Fever (body temperature >37.5°C)	6 (75 %)	2 (100%)	2 (100%)	2 (50%)
Dry cough	5 (62.5%)	2 (100%)	2 (100%)	1 (25%)
Dyspnea / tachypnea	3 (37.5%)	2 (100%)	1 (50%)	0
Pharyngeal congestion or sore throat	3 (37.5%)	1 (50%)	1 (50%)	1 (25%)
Vomiting or diarrhea	3 (37.5%)	0	2 (100%)	1 (25%)
Hypoxia	2 (25%)	2 (100%)	0	0
Radiography				
Pulmonary consolidation	2 (25%)	1 (50%)	1 (50%)	
Ground-glass opacities	4 (50%)	2 (100%)	1 (50%)	1 (25%)
Lung Ultrasound				
Pulmonary consolidation	2 (25%)	1 (50%)	1 (50%)	0
Interstitial B-lines pattern	5 (62.5%)	2 (100%)	2 (100%)	1 (25%)

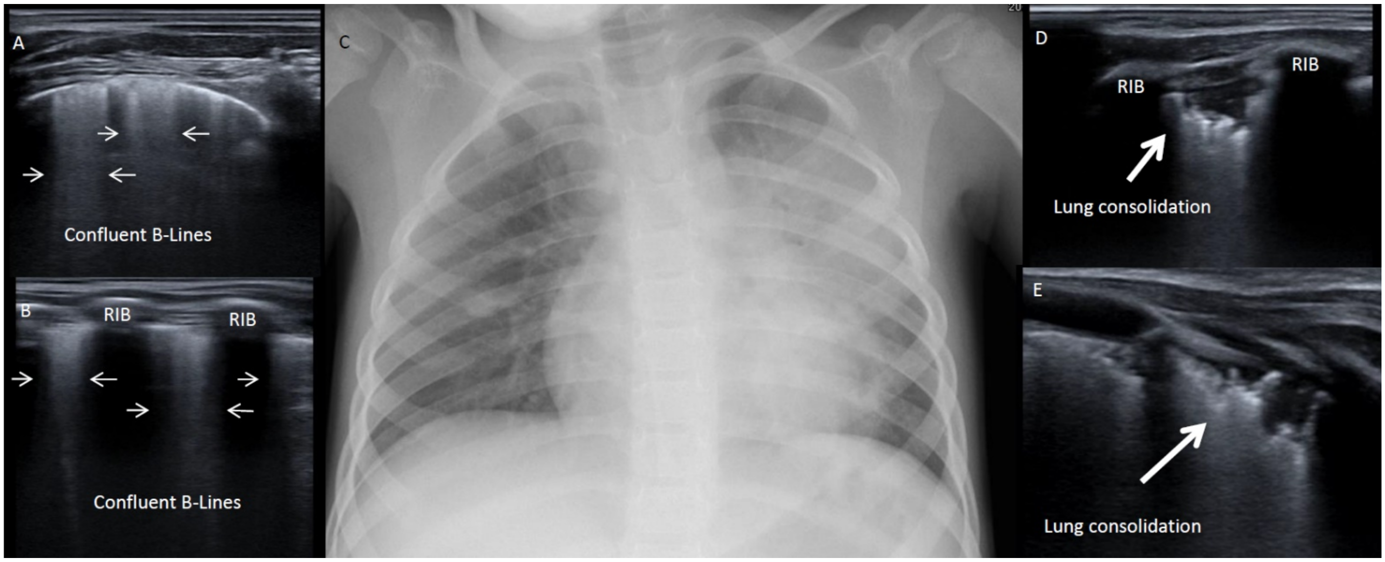

Figure 1: In image C chest radiography with left upper lobe consolidation and right central ground-glass opacities; in images A and B multiple confluent B-lines (thin arrows) and in images D and E a lung consolidation (thick arrows) at lung ultrasound.

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