

Short report – Usefulness of point-of-care ultrasound in pediatric SARS-CoV-2 infection

J.L. VAZQUEZ MARTÍNEZ¹, C. PÉREZ-CABALLERO MACARRÓN¹, A. COCA PÉREZ¹, R. TAPIA MORENO¹, E. OTHEO DE TEJADA²

¹PICU, Ramón y Cajal University Hospital, Madrid, Spain

²Pediatric Infectious Disease, Pediatrics Department Ramón y Cajal University Hospital, Madrid, Spain

Abstract. – SARS-CoV-2 infection in children is uncommon compared to adult population. However, some children required hospital and/or PICU admission. The aim of this short communication is to share our experience with Point-of-Care Ultrasound (POCUS) when managing these patients. Remarkably, all cases presented pleural and pericardial effusions, detected by POCUS, despite showing an adequate urinary output and prior to receiving any kind of fluid resuscitation. Effusions have been described as rare among SARS-CoV-2 infection in adult population. By performing portable chest X-Ray they would have gone unnoticed in our patients. Other POCUS findings consisted of all types of consolidations and coalescent B-line patterns. POCUS was also performed in order to optimize PEEP, checking adequate endotracheal intubation positioning (avoiding the risk of contagiousness related to auscultation in this framework), and to assess volemia status, cardiac performance, and brain neuro-monitoring. There was not cross-infection. In pediatric SARS-CoV-2 effusions are frequent but easily unnoticed unless lung and echo POCUS are performed.

Key Words:

Point-of-Care Ultrasound (POCUS), Pediatric COVID 19, Pleural effusions, Pericardial effusion.

Abbreviations

ARDS = acute respiratory distress syndrome; CT scan = computer tomography scan; CXR = chest X-ray; Echo = echocardiography; ONS = optic nerve sheath; PE = pericardial effusion; PEEP = positive end-expiratory pressure; PICU = Pediatric Intensive Care Unit; POCUS = Point-of Care Ultrasound; SARS-Cov-2 = Severe Acute Respiratory Syndrome Coronavirus 2.

Introduction

Point-of-Care Ultrasound (POCUS) is essential when managing pediatric critical patients. The 2019 Novel Coronavirus infection (SARS-

CoV-2) is being mostly described affecting adult patients. Recently, it has been published a large pediatric series from China¹ some of them on critical conditions. Up to 15 May, Spain and specially Madrid area resulted also affected, with 66,000 patients up to this moment. In adult population SARS-CoV-2 can cause pneumonia, together with hemodynamic and acute lung failure in the early disease stage. According to the current literature, COVID-19 seems to be a less severe disease for children than adults although a subset of pediatric patients develop severe disease requiring PICU admission^{2,3}. Chest CT scan is considered the desirable imaging diagnostic method in SARS-CoV-2 pneumonia⁴, but it is not a bedside tool, and it implies a high risk because of the need of transferring critical patient out of ICU considering its high contagiousness. Other alternatives, such as portable chest radiography (CXR) unfortunately provides a poor quality image. In this setting, point-of-care ultrasound (POCUS) emerges as an excellent option for managing these patients.

In this short-communication, we summarize the usefulness of POCUS in 3 pediatric cases, two of them admitted to PICU because of ARDS. All children had positive result for SARS-CoV-2 PCR in a nasopharyngeal swab sample. All ultrasound scans were performed by using Edge II, Sonosite[®] (Bothell, WA, USA). Lungs were scanned using L25[×] (13-6MHz) linear probe, by using specific lung software setting. 10 areas were studied in each hemithorax (4 anterior, between sternal and anterior axillary lines; 2 lateral between anterior and posterior axillary lines, and 4 posterior, between para-vertebral and posterior axillary lines). An echo (subcostal axis) was also performed by using P10^x (8-4 MHz) probe in order to assess cardiac performance, volemia (aortic peak velocity variability) and to rule in and out

pericardial effusion. We also neuro-monitored the two critical children by performing serial optic nerve sheath (ONS) and Doppler transcranial (DTC) measurements. In order to avoid cross-infection, all probes were cleaned and disinfected by using specific hydro-alcoholic solutions prior and after the scanning, and protected with a sterile cover.

In all 3 patients, pleural effusions were detected, being these findings described as rare among COVID-19 pediatric and adult case^{5,6}. Other SARS-CoV-2 infection lung ultrasound findings consisted on diffuse subpleural and translobar consolidations, coalescent B-lines and irregularities of pleural line (Figure 1) (ESM 1 video). No A-lines pattern was founded. Most affected zones were the gravitational ones (posterior and basal), alternating with spared areas. In the most severely affected child with oxygenation index over 12, POCUS allowed us to guide PEEP management by scoring the lung aeration patterns⁷. Related to echo, we preferably used the subcostal axis as it allowed us to check cardiac performance, pericardial effusion (PE) (ESM video 2), volemia and tip catheter position in an easy and rapid approach. Moreover, as the patient with severe ARDS was supported with high PEEP level, transthoracic echo (four-chamber, long- and short axis) scanning was precluded. In all cases the cardiac function resulted normal. Once again, the 2 critical patients showed at the moment of PICU admission mild PE despite they had not previously received fluid resuscitation, showing a normal urinary output. PE was not associated

with hemodynamic compromise. POCUS was also performed when the ARDS patient aging 5 months was intubated, in order to check the tube position, thus avoiding the need of auscultation which has been described as high-risk medical contamination procedure⁸, especially when not-cuffed endotracheal tubes are used. POCUS was also performed to guide vascular access canalization, urinary and gastric tubes positioning, and to assess hemodynamic status, brain flow and intracranial pressure (Figure 2). After a follow-up of 3 months, all patients are asymptomatic with echo normal but persisting pleural thickening without effusions.

Contrary to adult and other pediatric published series, effusions were present in all cases. Drainage was not required in any patient. When comparing portable CXR with lung ultrasound, pleural effusion was only identified by ultrasound, which has a better sensitivity compared to CXR⁹. The role of these effusions as a sign of inflammation in SARS-CoV-2 disease is currently unknown but we speculate that small effusions in children are actually more frequent than described before. However, without performing bedside lung ultrasound and echo they can go unnoticed, especially in pediatric population where chest CT scan is particularly discouraged due to ionizing radiation. Another main difference to adult series is the absence of light beam sign among our pediatric patients, maybe due to the fact that this recently described sign just occurs when lung ultrasound is performed by using a convex probe in oblique axis¹⁰.

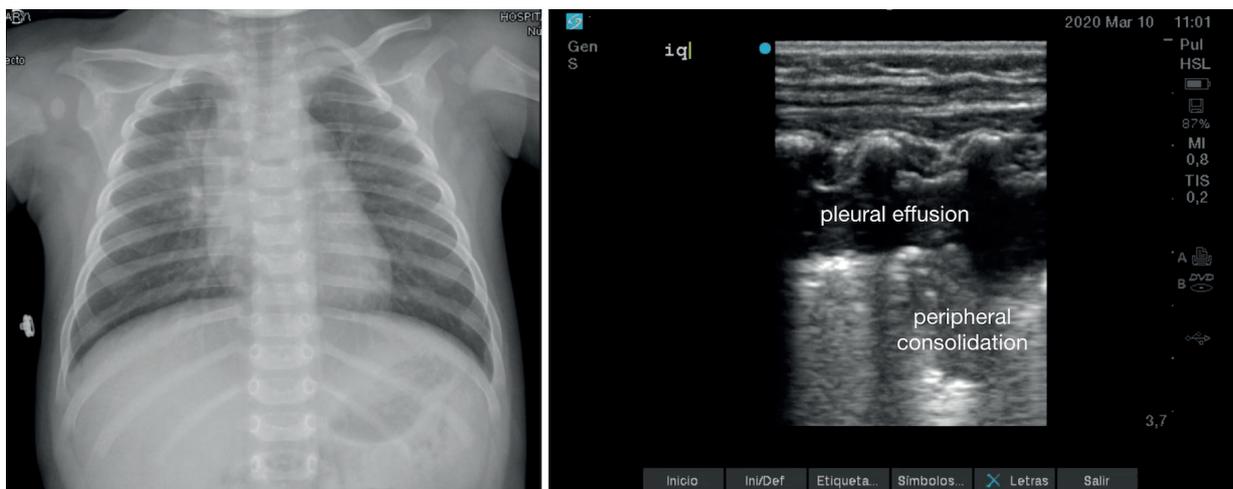


Figure 1. *Left:* CXR showing not pleural effusion; *Right:* Lung ultrasound showing small consolidation with surrounding coalescent B-line, and pleural effusion.

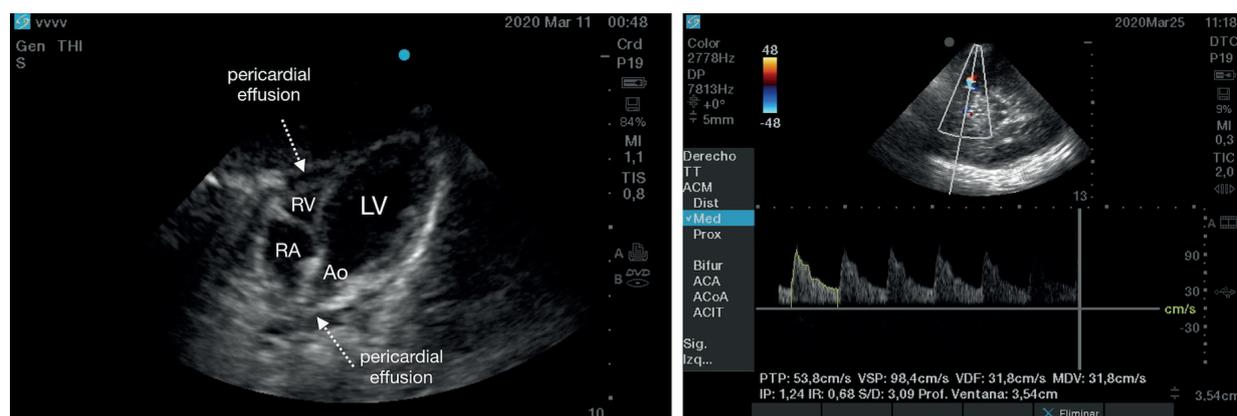


Figure 2. *Left:* Pericardial effusion (subcostal axis); *Right:* Transcranial doppler for assessing brain flow status. Ao: aortic chamber; RA: right atrium; RV: right ventricle; LV: left ventricle.

In conclusion, and opposed to other authors¹¹, we consider it is very important to perform POCUS in SARS-CoV-2 pediatric infection as an immediate, repetitive, and non-invasive diagnostic tool, which has also been shown to be a safe procedure, with no cross-infection¹². Without performing POCUS, effusions go unnoticed.

Conflict of Interest

The Authors declare that they have no conflict of interests.

References

- 1) DONG Y, MO X, HU Y, QI X, JIANG F, JIANG Z, TONG S. Epidemiological characteristics of 2143 pediatric patients with 2019 Coronavirus Disease in China. *Pediatrics* 2020; 58: 712-713.
- 2) CHAO JY, DERESPINA K, HEROLD BC, GOLDMAN DL, ALDRICH M, WEINGARTEN J, USHAY HM, CABANA MD, MEDAR SS. Clinical characteristics and outcomes of hospitalized and critically ill children and adolescents with Coronavirus Disease 2019 (COVID-19) at a tertiary care medical center in New York City. *J Pediatr* 2020. Doi: 10.1016/j.jpeds.2020.05.006 [Epub ahead of print].
- 3) TAGARRO A, EPALZA C, SANTOS M, SANZ-SANTAEUFEMIA FJ, OTHEO E, MORALEDA C, CALVO C. Screening and severity of Coronavirus Disease 2019 (COVID-19) in children in Madrid, Spain. *JAMA Pediatr* 8: e201346.
- 4) FENG P, TIANHE Y, PENG S, SHAN G, BO L, LINGLI L, DANDAN Z, JIAZHENG W, RICHARD L. H, LIAN Y, CHUANSHENG Z. The course of lung changes on chest CT during recovery from 2019 novel coronavirus (COVID-19) pneumonia. *Radiology* 2020; 13: 200370.
- 5) PENG OY, WANG, ZHANG LN; CHINESE CRITICAL CARE ULTRASOUND STUDY GROUP (CCUSG). Findings of lung ultrasonography of novel coronavirus pneumonia during the 2019-2020 epidemic. *Intensive Care Med* 2020; 46: 849-850.
- 6) GREGORIO-HERNÁNDEZ R, ESCOBAR-IZQUIERDO B, COBAS-PAZOS J, MARTÍNEZ-GIMENO A. Point-of-care lung ultrasound in three neonates with COVID-19. *Eur J Pediatr* 2020; 1-7. doi: 10.1007/s00431-020-03706-4. Online ahead of print.
- 7) MAYO P, VOLPICELLI G, LEROLLE N, SCHREIBER A, DOELKEN A, VIEILLARD-BARON A. Ultrasonography evaluation during the weaning process: the heart, the diaphragm, the pleura and the lung. *Intensive Care Med* 2016; 42 : 1107-1117.
- 8) CHEUNG J, HO LT, CHENG JV, CHAM YK, LAM KN. Staff safety during emergency airway management for COVID-19 in Hong Kong. *Lancet Respir Med* 2020; 8: e19.
- 9) ZANFORLIN A, GIANNUZZI R, NARDINI S, TESTA A, SOLDATI G, COPETTI R, MARCHETTI G, VALENTE S, INCHINGOLO R, SMARGIASSI A. The role of chest ultrasonography in the management of respiratory diseases: document I. *Multidisciplinary Respiratory Medicine* 2013; 8: 54.
- 10) VOLPICELLI G, LAMORTE A, VILLÉN T. What's new in lung ultrasound during the COVID-19 pandemic. *Int Care Med* 2020; 46: 1445-1448.
- 11) SCHEIER E, GURI A, BALLA U. Lung ultrasound cannot be used to screen for COVID-19 in children. *Eur Rev Med Pharmacol Sci* 2020; 24: 4623-4624.
- 12) BUONSENSO D, PIANO A, RAFFAELLI F, BONADIA N, DE GAETANO DONATI K, FRANCESCHI F. Point-of-Care Lung Ultrasound findings in novel coronavirus disease-19 pneumoniae: a case report and potential applications during COVID-19 outbreak. *Eur Rev Med Pharmacol Sci* 2020; 24: 2776-2780.