Pediatric Pulmonology

WILEY

CLINICAL CORRESPONDENCE

Bedside Point of Care Ultrasound—Lung (POCLUS) in Paediatric Complicated Community-Acquired Pneumonia: Diagnosis, Monitoring, and Treatment Guidance. The Experience of a Tertiary Care Center

Maria Alessia Mesturino[1] | Mariangela Irrera[2,3] | Giulia Testa[2,3] | Annarita Iadecola[4] | Elena Boccuzzi[1] | Costanza Tripiciano[5] | Giulia Lorenzetti[5] | Valerio Pardi[6] | Danilo Buonsenso[7] | Alberto Villani[1,8] | Anna Maria Musolino[1]

[1]Pediatric Emergency and General Pediatrics Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy | [2]Academy of Pediatrics, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy | [3]University of Rome Tor Vergata, Rome, Italy | [4]NESMOS Department, Faculty of Medicine and Psychology, Sapienza University of Rome, Pediatric Unit, Sant' Andrea University Hospital, Rome, Italy | [5]Infectious Disease Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy | [6]General Pediatric Surgery Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy | [7]Pediatric Area, Department of Life Sciences and Public Health, Catholic University of the Sacred Heart, Rome, Italy | [8]Chair of Pediatrics, Department of System Medicine, University of Rome Tor Vergata, Rome, Italy

Correspondence: Mariangela Irrera (mariangela.irrera@opbg.net)

Received: 6 March 2025 | **Revised:** 21 November 2025 | **Accepted:** 8 December 2025

Funding: European Union - Next Generation, Grant/Award Number: PNRR-POC-2022-12375777-CUP; Italian Ministry of Health with Current Research funds, Grant/Award Number: E83C22006510001

Keywords: children | lung ultrasound | pneumonia

To the Editor,

This article reports three pediatric cases of Complicated Community-acquired pneumonia (CCAP), emphasizing the pivotal role of bedside Point-of-Care Lung ultrasound (POCLUS) in diagnosis, monitoring, and treatment guidance.

1 | Case 1

A 15-year-old boy was referred to our emergency department (ED) with a right-sided pleuropneumonia previously diagnosed at another hospital through chest X-ray (CXR) and Computed Tomography (CT) scan. Blood tests revealed an increase of C-Reactive Protein (CRP) 27.7 mg/dL (normal values 0–0.5 mg/dL). A first POCLUS was performed (see E-text for methodology), revealing necrotizing pneumonia with pleural effusion at the base of the right lung (Figure 1A). Microbiological tests identified Staphylococcus aureus and Influenza A virus. Therapy with Meropenem, Linezolid, and Oseltamivir was started. On the 6th day, due to the worsening patient's clinical condition, an initial chest Magnetic Resonance Imaging (MRI) was performed, which showed the presence of consolidation/atelectasis characterized by a large area of necrotic cavity with a diameter of about 11 cm (Figure 1B). This lesion was also detected using POCLUS, appearing as an anechoic area, but it was not visualized on the CXR. Sputum and blood cultures identified Methicillin Sensitive Staphylococcus Aureus, so antibiotic therapy was adjusted to Rifampicin and Oxacillin, leading to gradual clinical improvement. On the 15th day, POCLUS demonstrated a reduction in the hypoechoic area, a partial re-aeration of the lung, and a decrease in pleural effusion thickness (Figure 1C). On the 21st day, POCLUS and MRI (Figure 1D) revealed further improvement. After 28 days, the patient was discharged in good health. Follow-up LUS showed a complete restoration of the lung in ten months.

2 | Case 2

A 5-year-old child presented to our ED with a 4-day history of fever and cough. Physical examination revealed reduced breath

Abbreviations: CAP, community acquired pneumonia; CCAP, complicated community-acquired pneumonia; CMV, citomegalovirus; CRP, C-reactive protein; CT, computed tomography; CXR, chest X-ray; ED, emergency department; LUS, lung ultrasound; POCLUS, Point-of-Care Lung ultrasound.

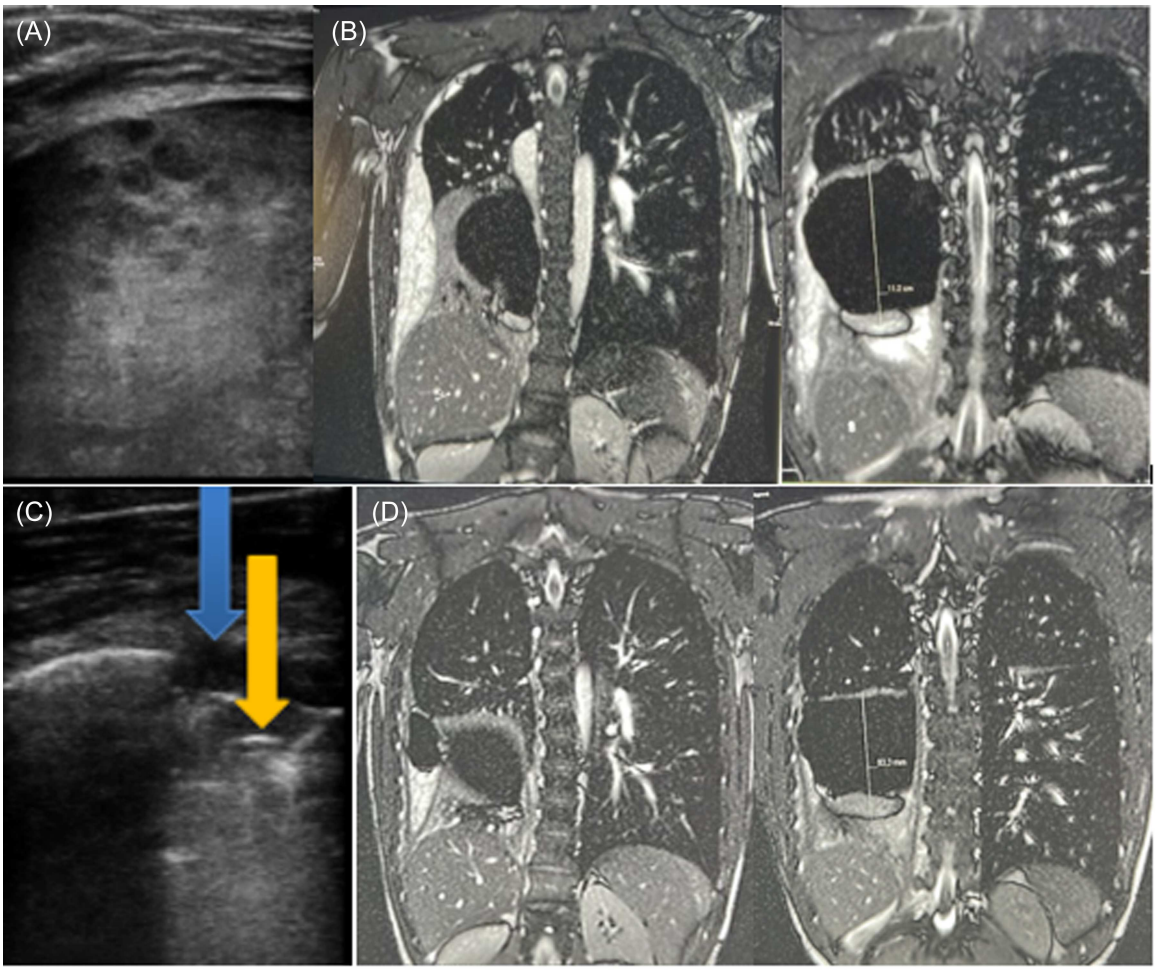

FIGURE 1 | First case report. (A) POCLUS with linear probe in transverse position, highlighting lung consolidation with numerous rounded hypo-anechoic lesions (cavity necrosis). (B) Chest MRI with dynamic TRUFI sequences showing complicated pneumonia affecting the right lung. In the right paracardiac supradiaphragmatic site, the presence of consolidation/atelectasis is characterized by a large area of cavity necrosis within a maximum diameter of approximately 11 cm with an air-fluid level. (C) POCLUS with linear probe in transverse position showing air bronchograms and reappearance of normal pulmonary artefactual structure with small pleural effusion. (D) Chest MRI with free-breathing TRUFI sequences showing improvement of cavity lesion with maximum diameter of approximately 9 cm. [Color figure can be viewed at wileyonlinelibrary.com]

sounds in the left mid-basal region. Laboratory tests revealed elevated inflammatory markers (CRP 23 mg/dL), and CXR revealed a retrocardiac pneumonia with ipsilateral pleural effusion. Empirical therapy with amoxicillin-clavulanic acid was started. Microbiological investigations were performed, and the urinary pneumococcal antigen test yielded a positive result. On the following day, POCLUS confirmed CCAP, prompting the addition of clarithromycin to the treatment strategy. On the 5th day, despite a decrease in CRP (7.69 mg/dL), the patient's clinical condition deteriorated. POCLUS showed a worsening of CCAP with complicated pleural effusion (Figure 2), so clarithromycin was replaced with teicoplanin. Even if blood tests were stable (CRP 7.31 mg/dL), clinical conditions continued to worsen. A new POCLUS revealed an increase in pleural effusion and pulmonary consolidation with the appearance of a rounded, centimeter-sized hypoechoic lesion suggestive of cavitary necrosis. Ultrasound findings guided therapeutic changes to Meropenem. After a week, chest CT scan and POCLUS demonstrated resolution of pleural effusion and reduction in pulmonary consolidation. The patient was discharged in good general condition after 23 days of hospitalization.

3 | Case 3

A 17-year-old boy presented to our ED with a 2-day history of left-sided chest pain and acute respiratory failure. CXR and chest CT revealed a left basal pleuropneumonia. Blood tests showed an increase in CRP (25.7 mg/dL). POCLUS confirmed CCAP, so empiric therapy with ceftriaxone was started. Film Array Respiratory panels on nasopharyngeal swabs tested positive for Metapneumovirus. Due to the patient's poor condition, therapy was escalated with the addition of teicoplanin.

On the 10th day, despite improvements in blood tests, the patient's clinical condition worsened. POCLUS revealed a progression of the pleural effusion with the development of an empyema measuring approximately 11 cm in length and 4 cm in depth located posteriorly in the left subscapular region (Figure 3A), findings confirmed by CXR and CT scan (Figure 3B). Due to the unfavorable location, drainage of the empyema was not feasible. Consequently, teicoplanin was discontinued and replaced with Linezolid. A POCLUS performed 9 days later showed a reduction in pleural effusion, consistent with the patient's clinical improvement, so he was discharged in good general condition (Table 1).

4 | Discussion

Community-acquired pneumonia (CAP) is the largest single cause of morbidity and mortality worldwide in children aged between 28 days and 5 years [1].

Although most children with CAP recover, some children develop local or systemic complications.

According to the British Thoracic Society Pediatric Pneumonia Audit, approximately 3% of CAP become CCAP [2], with parapneumonic effusion being the most common complication, observed in up to 10% of cases [3]; other local complications can be empyema, necrotising pneumonia, and lung abscess.

From a diagnostic imaging perspective, a CT scan is considered the gold standard for diagnosing CCAP, while CXR remains the primary tool for follow-up.

Regarding ultrasound, the role of POCLUS in CAP is well-established [4], but the current literature lacks reports on the role of POCLUS in CCAP.

A.M. Musolino et al. described some early lung features (air and liquid, deep, and fixed, or not very dynamic bronchograms) seen on ultrasonography that might predict the development of CCAP [5].

Based on these premises, we investigated the role of POCLUS in the diagnosis and follow-up of CCAP, evaluating the correlation between changes in ultrasound patterns and patients' clinical status, vital signs, and laboratory findings.

In all reported cases, POCLUS was revealed to be a valuable tool for diagnosis, monitoring, and guiding therapeutic decisions. Its findings showed good correlation with CXR and CT, while offering the added benefit of reducing both radiation exposure and the healthcare costs associated with more complex imaging modalities during follow-up. In certain cases, it was able to show clinical deterioration earlier than blood exams, facilitating timely decisions regarding therapeutic adjustments and invasive procedures.

Naturally, this diagnostic tool has certain limitations, including the requirement of a highly experienced operator, as well as longer execution time compared to CXR.

In conclusion, based on our experience of a Tertiary Care, POCLUS has several strengths in the diagnosis and monitoring of CCAP: it is non-invasive, rapid, and available for point-of-care use, enabling both real-time diagnosis and follow-up. Furthermore, POCLUS can support clinical decision-making regarding the optimal timing for second-level imaging, thereby contributing to a reduction in cumulative exposure to ionizing radiation. However, further studies are needed to strengthen these preliminary findings.

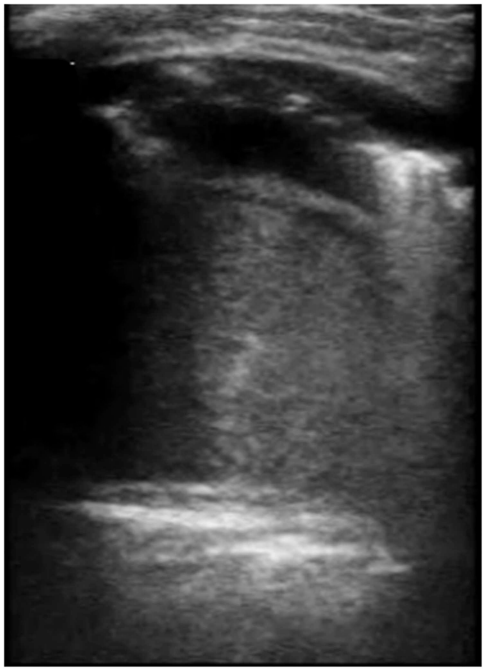

FIGURE 2 | Second case report. POCLUS with linear probe in transverse position, which highlights worsening of the pulmonary consolidation, which appears extensive, located posteriorly in the left mid-basal area, with a diameter of approximately 3.6 cm, with sub-centimetric pleural effusion with fibrin shoots in its context.

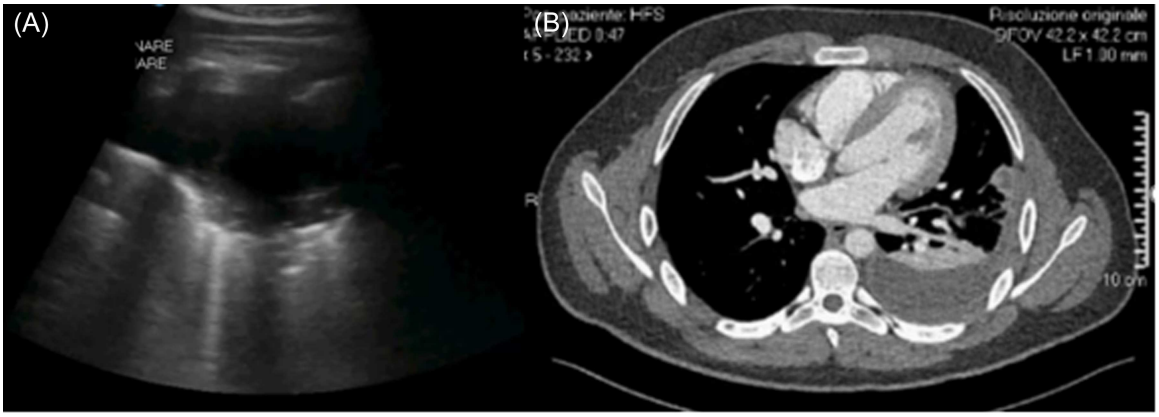

FIGURE 3 | Third case report. (A) POCLUS with convex probe in longitudinal position showing presence of corpuscular liquid collection with a diameter of 11 cm in length and 4 cm in depth on the left posterior mid-basal area, with atelectatic underlying lung with air bronchogram. (B) Chest CT without and with contrast showing increased sac pleural effusion with suprahydric density for corpuscular quota in the context, located on the left in the posterior recess, with maximum extension at the VII posterior intercostal space with longitudinal diameter of 20 cm, transversal diameter of 8.4 cm and antero-posterior diameter of 3.8 cm.

TABLE 1 | Summary of demographic, clinical, microbiological, and serial Point of Care Lung Ultrasound (POCLUS) findings for three pediatric cases of complicated community-acquired pneumonia, illustrating the role of POCLUS in guiding diagnostic and therapeutic management.

Case n° (age/sex)	Diagnosis on admission	Microbiological agent	Ultrasound changes	POCLUS-guided interventions	Length of stay (days)	Time to resolution (months)
1 (15 years/M)	Right-sided pleuropneumonia	Methicillin-Sensitive Staphylococcus Aureus and Influenza A	Time 0 (on admission): Right-sided necrotizing pneumonia with pleural effusion Time 1 (6th day): necrotic cavity Time 2 (15th day): reduction in the hypoechoic area, reappearance of A-lines and decrease in pleural effusion thickness Time 3 (21st day): further improvement	– Initial assessment of severity – Monitoring of non-response: tracked the evolution of the large necrotic cavity (missed by Chest X-ray), supporting the need for a therapy adjustment. – Follow-up: serial POCLUS demonstrated a positive response to targeted antibiotics.	28	10
2 (5 years/M)	Left-sided retrocardiac pleuropneumonia	Streptococcus Pneumoniae	Time 0 (1st day): Left-sided pneumonia with pleural effusion Time 1 (5th day): complicated pleural effusion Time 2 (7th day): increase in pleural effusion and appearance of cavitary necrosis Time 3 (14th day): resolution of pleural effusion and reduction of lung consolidation	– Guided sequential antibiotic changes, overriding misleading laboratory findings. – Follow-up: monitored therapeutic response and resolution.	23	1
3 (17 years/M)	Left-sided basal pleuropneumonia	Metapneumovirus	Time 0 (on admission): Left-sided basal pneumonia with pleural effusion Time 1 (10th day): appearance of empyema Time 2 (19th day): reduction in pleural effusion	– Revealed a large empyema in a location unsuitable for drainage. This finding explained the clinical worsening and guided the decision to escalate medical therapy.	20	2

Author Contributions

Maria Alessia Mesturino: conceptualization, investigation, writing – review, and editing. **Mariangela Irrera:** writing – original draft, writing – review, and editing. **Giulia Testa:** data collection and writing – original draft. **Annarita Iadecola:** data collection and writing – original draft. **Elena Boccuzzi:** data collection and writing – review. **Costanza Tripiciano:** writing – review and editing. **Giulia Lorenzetti:** writing – review and editing. **Valerio Pardi:** writing – review and editing. **Danilo Buonsenso:** writing – review and editing. **Alberto Villani:** conceptualization, supervision, writing – review, validation. **Anna Maria Musolino:** conceptualization, supervision, writing – review, validation. All the authors approved the final manuscript in the present version and agreed to be accountable for everything concerning it.

Acknowledgments

This work was funded by the European Union - Next Generation EU-NRRP M6C2-Investment 2.1, Enhancement and strengthening of biomedical research in the NHS. PNRR-POC-2022-12375777-CUP E83C22006510001. This work was supported also by the Italian Ministry of Health with Current Research funds.

Ethics Statement

This study was approved by Bambino Gesù Children's Hospital's Ethics Committee with the resolution dated 15/11/2023. Protocol: PNRR-POC-2022-12375777 ID 5474. Draft collaboration and data transfer agreement_ Ultrasonic-CAP rev_FL290224_rev.FP.13.03.24(003). This study was conducted in accordance with the local legislation and institutional requirements. Written informed consent was obtained from minors' legal guardians for the publication of any potentially identifiable images of data included in this article. Written informed consent was obtained from the patients' legal guardians for the publication of this case series.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data available on request from the authors.

References

1. C. Troeger, B. Blacker, I. A. Khalil, et al., "Estimates of the Global, Regional, and National Morbidity, Mortality, and Aetiologies of Lower Respiratory Infections in 195 Countries, 1990–2016: A Systematic Analysis for the Global Burden of Disease Study 2016," *Lancet Infectious Diseases* 18, no. 11 (2018): 1191–1210, https://doi.org/10.1016/S1473-3099(18)30310-4.

2. S. J. M. Bowen and A. H. Thomson, "British Thoracic Society Paediatric Pneumonia Audit: A Review of 3 Years of Data," *Thorax* 68, no. 7 (2013): 682–683, https://doi.org/10.1136/thoraxjnl-2012-203026.

3. J. E. Clark, D. Hammal, D. Spencer, and F. Hampton, "Children With Pneumonia: How Do They Present and How Are They Managed?," *Archives of Disease in Childhood* 92, no. 5 (2007): 394–398, https://doi.org/10.1136/adc.2006.097402.

4. M. S. Toro, J. L. V. Martínez, R. V. Falcão, A. Prata-Barbosa, and A. J. L. A. Cunha, "Point-of-Care Ultrasound by the Pediatrician in the Diagnosis and Follow-Up of Community-Acquired Pneumonia," *Jornal De Pediatria* 97, no. 1 (2021): 13–21, https://doi.org/10.1016/j.jped.2020.07.003.

5. A. M. Musolino, P. Tomà, M. C. Supino, et al., "Lung Ultrasound Features of Children With Complicated and Noncomplicated Community Acquired Pneumonia: A Prospective Study," *Pediatric Pulmonology* 54, no. 9 (2019): 1479–1486, https://doi.org/10.1002/ppul.24426.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.
Supplementary Information