Usefulness of Thoracic Ultrasound in the Diagnosis of Pneumonia in Pediatric Patients

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Abstract

Pneumonia remains one of the leading causes of mortality in children under five years of age, particularly in low- and middle-income countries. Although chest radiography is the standard diagnostic method, it has limitations such as radiation exposure and reduced sensitivity in certain cases. In this context, lung ultrasound has emerged as an effective, safe, and accessible diagnostic tool, This method allows for the identification of typical pneumonia signs such as consolidations and dynamic air bronchograms, with high sensitivity (96%) and specificity (93%), according to recent studies. Furthermore, its portability and ease of use make it suitable for clinical settings with limited resources. Thoracic ultrasound thus represents a valuable diagnostic alternative in pediatric care.

Introduction

Pneumonia continues to be one of the most relevant infectious pathologies in childhood, which justifies the constant review of the available diagnostic tools. According to the latest WHO global report (2023), pneumonia still represents one of the leading causes of infant mortality, with more than 740,000 deaths in children under five years of age worldwide in 2022, being responsible for 14% of all deaths in this age group (WHO, 2023). Although there has been a significant reduction compared to 2013 data (935,000 deaths), this pathology continues to be a significant burden on public health, especially in low- and middle-income countries such as Colombia. In this country, it is estimated that acute respiratory infections accounted for about 13% of infant mortality in 2022 (Colombian Ministry of Health, 2023).

Pneumonia is an acute respiratory infection characterized by the involvement of the lung parenchyma, especially at the alveolar level, where inflammatory fluid accumulates, which prevents adequate gas exchange and can trigger severe hypoxemia and death if not treated in a timely manner (Lanspa et al., 2019).

Its etiology remains predominantly microbial. According to a recent meta-analysis (Kalil et al., 2021), Streptococcus pneumoniae remains the most common bacterial agent, present in up to 45% of confirmed cases, followed by respiratory syncytial virus (RSV) in approximately 22%. Viral-bacterial co-infection is also increasingly recognized. Fungi, such as Pneumocystis jirovecii, are observed in a smaller proportion and are related to immunosuppression.

Diagnosis

Clinical diagnosis in pediatrics follows a two-pronged approach: a first clinical phase based on respiratory signs and symptoms (tachypnea, retractions, fever, rales, etc.), complemented by radiological and laboratory studies, and a second etiological phase aimed at identifying the pathogen (Ginsburg & May, 2022). Although chest X-ray continues to be the reference standard, it has limitations: radiation exposure, limited accessibility in rural areas, and low sensitivity in some cases (Pereda et al., 2015).

Usefulness of ultrasound as a diagnostic alternative in pneumonia

Lung ultrasound has emerged as a viable and effective diagnostic alternative. This non-invasive, low-cost, radiation-free, and portable method allows the visualization of typical pneumonia findings such as subpleural consolidations, dynamic air bronchogram, and B-lines (Volpicelli et al., 2021). Ultrasonographic air bronchogram manifests as mobile hyperechogenic structures within consolidations and is highly suggestive of pneumonia. On the other hand, the liquid bronchogram is associated with bronchial obstructions and can be differentiated thanks to the use of color Doppler.

In addition, ultrasound lung consolidation, which indicates loss of aeration, is useful in differentiating pneumonia from atelectasis. In an updated 2023 meta-analysis (Iorio et al., 2023), thoracic ultrasound showed a sensitivity of 96% and a specificity of 93% for the diagnosis of pneumonia in pediatric patients, surpassing radiography in sensitivity.

Notably, ultrasound can be performed at the patient's bedside, making it a useful tool in emergency rooms, intensive care units, and regions with limited access to X-ray equipment. Its learning curve is short, and it can be executed by trained general practitioners.

Conclusion

Thoracic ultrasound is a valuable diagnostic tool in the detection of paediatric pneumonia. In addition to being an alternative with a better safety profile compared to radiography, its high sensitivity, portability and low cost position it as an essential technique in current pediatric care. Its wider implementation can significantly improve diagnostic access in challenging clinical contexts.

References

1. Ginsburg AS and May S. "Pediatric pneumonia: Clinical features, diagnosis, and treatment". The Lancet Child & Adolescent Health 6.1 (2022): 3-12.
2. Iorio G., et al. "Lung ultrasound in the diagnosis of pneumonia in children: A meta-analysis". Pediatric Pulmonology 58.1 (2023): 12-22.
3. Kalil AC., et al. "Management of adults with hospital-acquired and ventilator-associated pneumonia: 2021 Clinical practice guidelines by the IDSA and ATS". Clinical Infectious Diseases 73.3 (2021): e61-e111.
4. Lanspa MJ, Jones BE and Brown SM. "Mortality prediction models for pneumonia: A systematic review and meta-analysis". Journal of General Internal Medicine 34.7 (2019): 1217-1224.
5. Ministry of Health of Colombia. (2023). Weekly Epidemiological Bulletin - Infant Mortality from Pneumonia 2022. https://www.minsalud.gov.co
6. Pereda MA., et al. "Lung ultrasound for the diagnosis of pneumonia in children: A meta-analysis". Pediatrics 135.4 (2015): 714-722.
7. Volpicelli G., et al. "International evidence-based recommendations for point-of-care lung ultrasound". Intensive Care Medicine 47.3 (2021): 298-307.

8. World Health Organization (WHO). (2023). Pneumonia in children. https://www.who.int/news-room/fact-sheets/detail/pneu-monia