Pneumatocele in Focus: EIT's Colors of the Invisible

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Keywords

Electrical Impedance Tomography (EIT), Penumatocele, Paediatric Intensive Care, Pneumococcal pneumonia, Pediatric acute respiratory distress syndrome (pARDS)

To the Editor,

A previously healthy 4-year-old male child, weighing 12 kg, was admitted to our PICU for pneumococcal pneumonia complicated by right lower lobe empyema. The disease quickly progressed to severe pediatric acute respiratory distress syndrome (PARDS) and the patient was placed initially on conventional protective mechanical ventilation, then High-Frequency Oscillatory Ventilation (HFOV) and finally supported with Veno-Venous Extracorporeal Membrane Oxygenation in light of the impossibility of correcting the hypoxemia. In order to optimize Positive End-Expiratory Pressure (PEEP), during the phase of recovery from ECMO run we performed an Electrical Impedance Tomography (EIT) guided decremental PEEP trial from 14 cmH2O to 8 cmH2O in 2 cmH2O steps, with each level maintained for 10 minutes[1]. Introduced to the medical community for the first time in the late 1980s, EIT utilizes alterations in electrical impedance between air-filled and tissue or fluid-filled compartments to delineate and measure regional lung volume distribution at the patient's bedside. A fundamental tenet of EIT's approach to ventilation monitoring is not only mitigating global overdistension or collapse but also emphasizing regional characteristics. While its efficacy in the adult population has been extensively validated and established, its application in pediatric patients remains an area of ongoing investigation[2]. In our case, measurements were conducted using the PulmoVista 500 system (Dräger Medical, Lübeck, Germany) (Figure 1). Significantly, during the trial we were able to identify a region with ventilation delay (RVD) appearing at PEEP 14cmH2O. RVD refers to the delay between the onset of inspiration in the entire lung and the impedance curve specific to a particular region. As a result, RVD is usually used to identify lung regions experiencing delayed expansion[3]. In our case, owing to prior pulmonary tomographic imaging (Figure 2), the region of RVD was interpreted not merely as ventilation inhomogeneity but as the air-flow manifestation corresponding to a pneumatocele in the basal right lung. The presence of pneumatocele presents a challenge for clinicians managing patients on invasive ventilation. Due to their increased compliance and valve-like properties, insufficient ventilation characterized by excessively high PEEP levels carries the risk of pneumatocele overdistension, potentially resulting in rupture and/or formation of bronchopleural fistulas[4]. Conversely, an excessively conservative approach may contribute to generalized lung derecruitment, contributing to worsening the hypoxemia. Considering this insight, we successfully determined with EIT the optimal PEEP level to obtain either a reduction of alveolar dead space and the pneumatocele detente, minimizing the risk of ropture and developing a bronchopleural

fistula.

Managing mechanical ventilation in patients with severe PARDS, requiring VV ECMO, and presenting with pneumatocele, poses considerable challenges. However, as illustrated in the described case, EIT was instrumental in determining the optimal PEEP level to optimize ventilation and minimize pneumatocele-related risks, improving patient management and outcomes.

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Conflict of Interest statement

Dr. Bronco reports personal fees from Drager outside the submitted work. All other authors have nothing to disclose.

Ethics Statement

Informed consent was obtained from the child's parents for publication of case findings. The manuscript was authorized by the ethics committee of ASST Papa Giovanni XXIII (BG, Italy) according to resolution number 768 dated 24/05/2023.

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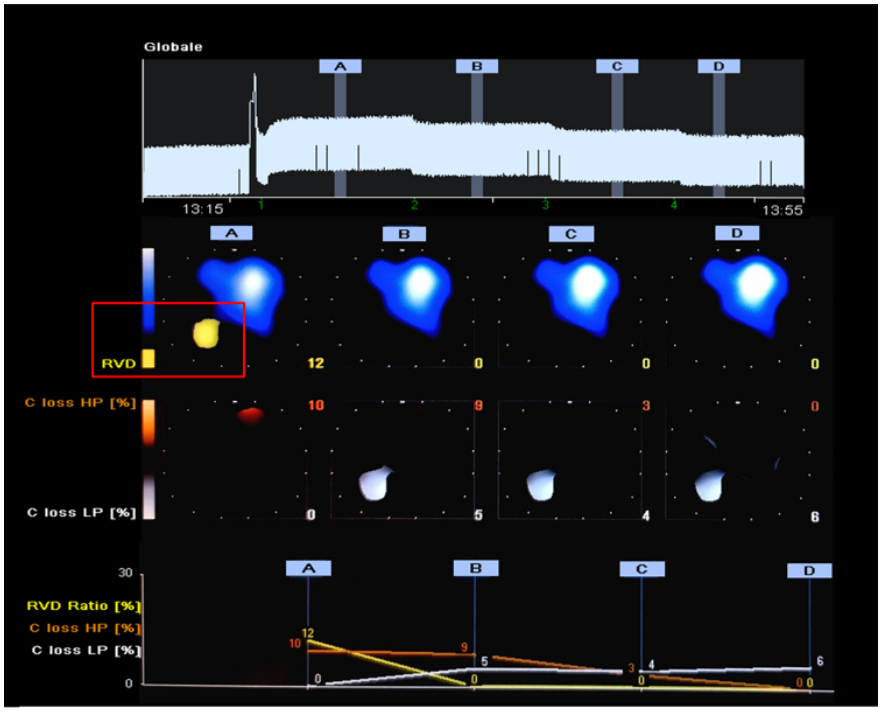

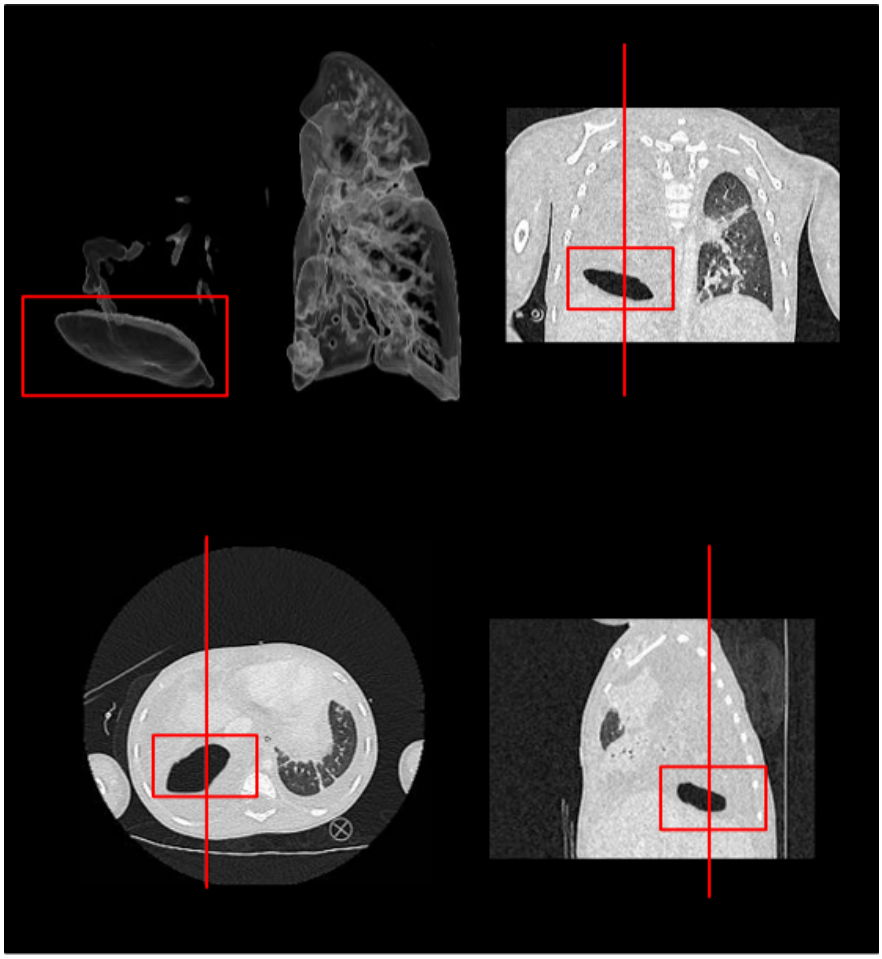

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