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Images

Electrical impedance tomography in pulmonary edema and hemorrhage

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A female baby with gestational age of 26 weeks and birth weight of 760 g was transferred to tertiary care on 9th day of life due to respiratory distress syndrome. The infant was clinically stable upon administration of continuous positive airway pressure (CPAP) of 6 cmH_2O on room air. The patient was included in an observational electrical impedance tomography (EIT) study (ClinicalTrials.gov: NCT04542096). An Enlight 1800 monitor (Timpel SA, Brazil) with 16 equally spaced electrodes on a neonatal belt circumferentially applied around the thorax was used to continuously record EIT data. Monitoring was initiated after the patient's admission. Six hours after transfer, oxygen demand increased (21%→40%) with simultaneous aggravation in work of breathing. Although CPAP was increased up to 8 cmH_2O, it produced no substantial effect. EIT data showed progressive loss of aeration in most of the left lung and dependent (posterior) lung regions (Fig. 1). A chest X-ray (CXR) was subsequently taken (Fig. 2) due to the further increase in respiratory distress and oxygen demand. Shortly afterward, massive pulmonary hemorrhage followed, and the patient was urgently intubated.

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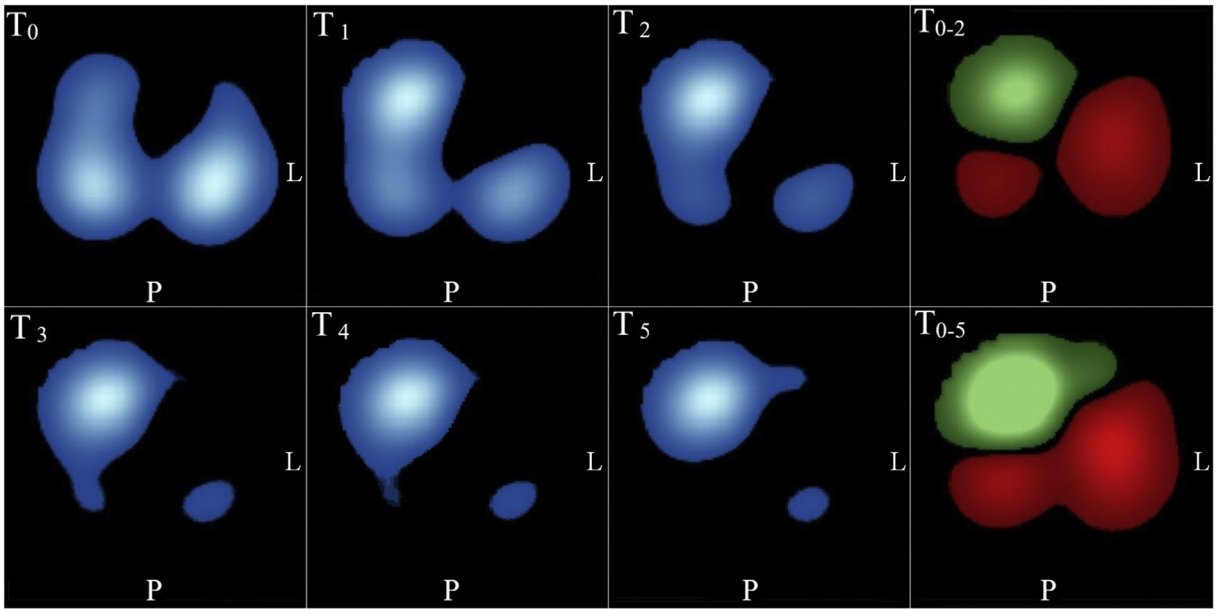

Figure 1 Electrical impedance tomography (EIT) images showing progressive loss of aerated lung tissue. Images represent the following corresponding time points: T_0, at admission; $T_{1,2,3,4,5}$, 360, 370, 380, 390, and 400 min after admission; T_{0-2} and T_{0-5}, aeration change between the T_0—T_2 and T_0—T_5 periods, respectively; L, left; and P, posterior. Blue illustrates aerated lung tissue; brighter areas correspond to more aerated lung regions and vice versa. Aeration loss and gain are represented by red and green, respectively.

Figure 2 Chest X-ray (CXR) image showing diffuse whiteout consistent with pulmonary edema/pulmonary hemorrhage.

Pulmonary hemorrhage (PH) is a severe, life-threatening condition characterized by massive bleeding into the lungs. It carries a high mortality rate and is associated with an increased rate of intraventricular hemorrhage and neurosensory impairment.[1,2] PH classically presents as pulmonary deterioration accompanied by a worsening general clinical condition. Hypoxia and increased need of respiratory support are directly proportional to the magnitude of a hemorrhage. Pulmonary edema frequently precedes PH in CXR, although it is a late finding. Despite its ominous nature being known for over 40 years, no early identification methods exist and outcomes remain dire. Related to this, EIT can be used for the earlier detection and diagnosis of pulmonary conditions manifesting with decreased aeration before they become clinically apparent.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to research, authorship, and/or publication of this article.

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