Abstract

K 鍵 : Pulmonary edema; Diagnosis; Treatment; Mechanisms; Cardiogenic; Non-cardiogenic

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Pulmonary edema (PE) refers to the abnormal accumulation of uid within the lung interstitium and alveolar spaces, which results in impaired oxygen exchange and respiratory distress. It is a serious medical condition with signi cant morbidity and mortality rates if not treated promptly. e pathophysiology of PE is diverse, with two main categories: cardiogenic and non-cardiogenic [1,2]. In cardiogenic pulmonary edema, le ventricular dysfunction leads to increased hydrostatic pressure in the pulmonary vasculature, causing uid leakage into the alveoli. In contrast, non-cardiogenic pulmonary edema occurs due to a variety of causes, including in ammation, capillary leakage, and altered permeability of the alveolar-capillary barrier [3]. Conditions like acute respiratory distress syndrome (ARDS), high-altitude pulmonary edema (HAPE), and neurogenic pulmonary edema fall under this category [4]. e clinical presentation of pulmonary edema varies depending on the etiology and severity but commonly includes symptoms such as severe dyspnea, orthopnea, cough with frothy sputum, and cyanosis. Hypoxemia is a hallmark sign, and the patient may exhibit tachypnea, tachycardia, and crackles on auscultation of the lungs [5]. Diagnosing PE involves a combination of clinical evaluation and diagnostic tests, including chest X-rays, echocardiography, and pulmonary function tests, which help con rm the presence of uid in the lungs and assess cardiac function. Treatment strategies for pulmonary edema are aimed at addressing the underlying cause and alleviating symptoms [6]. In cardiogenic PE, management typically includes diuretics, vasodilators, and medications to improve cardiac function. For non-cardiogenic causes, interventions like positive pressure ventilation, mechanical ventilation, and anti-in ammatory agents may be necessary [7]. Overall, early recognition and a tailored treatment approach are essential in improving patient outcomes. is review delves into the mechanisms, diagnostic methods, and treatment approaches for pulmonary edema, as well as the latest developments in clinical care [8].

Pulmonary edema can manifest through a variety of clinical symptoms and diagnostic ndings. In cases of cardiogenic pulmonary edema, imaging studies such as chest X-rays typically reveal bilateral alveolar in ltrates with a characteristic "butter y" pattern. Elevated B-type natriuretic peptide (BNP) levels and abnormal echocardiography ndings can indicate le ventricular dysfunction as the underlying cause. Conversely, non-cardiogenic pulmonary edema, such as ARDS, may show di use pulmonary in ltrates without the typical cardiogenic signs. Arterial blood gas analysis in PE o en demonstrates hypoxemia, and the PaO2/FiO2 ratio is an important marker for assessing the severity of ARDS. In clinical trials, early use of diuretics and vasodilators in patients with cardiogenic PE has been shown to reduce uid overload and improve symptoms more rapidly. Additionally, non-invasive positive pressure ventilation (NIPPV) has been increasingly used in cases of acute pulmonary edema to support gas exchange, especially in patients with COPD or heart failure exacerbations. Mechanical ventilation, particularly in ARDS patients, is o en required in severe cases to maintain oxygenation and prevent further lung injury. e overall success of these treatments is contingent upon timely intervention and appropriate monitoring, including continuous pulse oximetry and arterial blood gas measurements. Advancements in treatment protocols, such as the use of ultra ltration techniques for uid removal and tailored ventilation strategies, have led to improved survival rates and reduced complications in PE patients. Long-term outcomes also depend on managing the underlying cause, including chronic heart failure or ARDS.

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