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Acute Lung Injury and the Acute Respiratory Distress Syndrome

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I. CASE PRESENTATION

A 40-year-old man with no significant past medical history is brought to the emergency department (ED) after a motor vehicle accident in which he suffered a broken femur and a broken pelvis, and sustained multiple rib fractures. His blood pressure in the ED is 80/40 mm Hg; administration of lactated Ringer's solution is initiated for volume resuscitation. Low-dose dopamine is added to support his blood pressure. He is eventually taken to the operating room for surgical reduction and fixation of his femoral fracture.

On the second postoperative day, the patient is noted to have a cough with purulent sputum and fever. He also has evidence of respiratory distress, hypotension, and mental status changes. A chest radiograph reveals bilateral alveolar infiltrates. He remains hypoxemic despite receiving 50% oxygen by face mask. The hypotension is improved with a fluid challenge; however, the hypoxemia persists despite the administration of 100% oxygen by face mask.

Because of the patient's respiratory distress, tenuous hemodynamic profile, and mental status changes, emergency endotracheal intubation is performed. The postintubation chest radiograph demonstrates that the endotracheal tube is in satisfactory position, but bilateral pulmonary infiltrates are visible in all 4 quadrants. The patient is placed on mechanical ventilatory support with a tidal volume (V_T) of 8 mL/kg body weight, an initial fraction of inspired oxygen (FIO_2) of 1.0, and a rate of 16 breaths/min using the assist-control mode of support. Positive end-expiratory pressure (PEEP) is added at 5 cm H_2O. Shortly after intubation the patient is again found to be hypotensive, which persists despite the administration of 500 mL of normal saline solution. Dopamine and norepinephrine infusions are initiated to elevate the mean arterial blood pressure above 60 mm Hg, and a pulmonary artery catheter is inserted to monitor the hemodynamic function of the patient.

The patient's current hemodynamic profile is as follows: heart rate, 120 bpm; systemic blood pressure, 90/50 mm Hg; right atrial pressure, 3 mm Hg; right ventricular pressure, 30/10 mm Hg; pulmonary arterial pressure, 32/12 mm Hg; pulmonary artery occlusion pressure (PAOP), 12 mm Hg; cardiac output, 8.0 L/min, systemic vascular resistance, 600 (dyn × sec)/cm^5. The patient's arterial blood gas analysis on the ventilatory support already described demonstrates a pH of 7.35, $PaCO_2$ of 40 mm Hg, and a PaO_2 of 70 mm Hg. The patient is suspected to have the acute respiratory distress syndrome (ARDS).

- **What are the common risk factors for the development of ARDS?**
- **What are the criteria that support the diagnosis of ARDS?**
- **What are the current recommendations for ventilatory support of patients with ARDS?**

II. INTRODUCTION

HISTORY

For decades prior to the recognition of ARDS, it was understood that acute respiratory failure could result from a variety of different injuries and that this entity was characterized by the presence of diffuse pulmonary infiltrates accompanied by refractory hypoxemia despite the administration of high concentrations of supplemental oxygen. In 1967, Ashbaugh and Petty launched the modern era for this disorder and coined the term *adult respiratory distress syndrome* because of similarities to the infant respiratory distress syndrome. The disorder was associated with an extremely high mortality rate despite the provision of intensive therapy, ventilatory support, and the benefits of modern technology. Although the disorder had been named, confusion still existed because of uncertainty regarding the specific definition to use as well as an inability to determine the exact incidence of the syndrome (because there was no uniformly accepted definition to apply to all patient groups). It was difficult, if not impossible, to compare the results of clinical trials designed to improve the outcome of patients with ARDS. Attempts to impose order were further complicated by the lack of a specific diagnostic test for ARDS and the lack of uniform diagnostic criteria.