

Case Report

# Anesthetic Management for Emergency Orthopedic Surgery in a Patient with COPD and Asthma: A Case Report

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## Abstract

Orthopedic trauma patients with limited mobility and prolonged bed rest are at high risk of venous thromboembolism and pulmonary embolism (PE). When acute hypoxemia and respiratory dysfunction occur in such patients, it is clinically challenging to distinguish PE from acute exacerbation of underlying chronic obstructive pulmonary disease (COPD) or asthma, which directly affects perioperative safety. This study aimed to summarize the diagnostic thinking and standardized anesthetic management strategies for this type of high-risk emergency patient. We reported a 68-year-old male patient diagnosed with L2 burst fracture, who presented with severe hypoxemia (room-air SpO<sub>2</sub> 75%) before emergency surgery. Combined with the patient's medical history, lung auscultation, arterial blood gas analysis and chest computed tomography (CT) findings, we rapidly confirmed that hypoxemia was caused by acute airway obstruction rather than PE. Pre-intubation interventions including bronchodilators, corticosteroids and airway surface anesthesia were applied to prevent intraoperative bronchospasm. Intraoperative lung-protective ventilation was implemented, and stepwise respiratory support was adopted after extubation. The patient had an uneventful perioperative course and was discharged on the 5th postoperative day. In conclusion, for immobilized orthopedic trauma patients complicated with chronic airway diseases and acute respiratory abnormalities, comprehensive differential diagnosis combining clinical manifestations and auxiliary examinations is the premise of safe treatment. Targeted pre-operative prevention, standardized intraoperative ventilation and graded postoperative respiratory care can effectively reduce perioperative respiratory complications.

## Keywords

Emergency Orthopedic Surgery, COPD, Asthma, Differential Diagnosis, Pulmonary Embolism, Lung-protective Ventilation, Peri-extubation Management

## 1. Introduction

Orthopedic trauma patients frequently suffer from activity disorders and prolonged bed rest. Trauma-induced hypercoagulability increases the risk of deep vein thrombosis and poten-

tially fatal pulmonary embolism (PE) [1]. When acute respiratory dysfunction or hypoxemia develops in these patients, systematic differential diagnosis combining past medical history, clinical manifestations, D-dimer levels, and imaging

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studies is essential to differentiate PE from chronic respiratory diseases such as COPD and asthma [2]. Clinicians need to master the diagnostic criteria for acute PE in patients complicated with COPD, so as to avoid missed diagnosis and misdiagnosis [3]. For asthma patients undergoing surgery, standardized perioperative assessment and intervention are essential to reduce airway-related adverse events [4]. Meanwhile, it is necessary to formulate targeted diagnosis and treatment plans for acute exacerbation of COPD in acute care settings [5]. For patients with unexplained deterioration of respiratory function in COPD, PE is always an important differential diagnosis item [6].

## 2. Case Presentation

### 2.1. Patient Information

A 68-year-old male, 155 cm tall and weighing 60 kg, was admitted on June 3, 2025, with 5 days of low back and left thigh pain following a fall. He had restricted movement and required strict bed rest after injury.

### 2.2. Past Medical History

- 1) Hypertension for 5 years with irregular medication.
- 2) Childhood-onset asthma, exacerbated by cold exposure, without regular anti-asthma treatment.
- 3) Long-term chronic bronchitis reported by family.
- 4) History of right hernia surgery more than 50 years ago.

### 2.3. Key Auxiliary Examinations

- 1) D-dimer: 1.93 mg/L (elevated). Laboratory indicators such as D-dimer play an important auxiliary role in screening PE among high-risk orthopedic patients [7].
- 2) Lumbar MRI: L2 burst fracture with spinal canal stenosis.
- 3) Chest CT: bilateral chronic pulmonary inflammation; no evidence of PE, pneumothorax, or massive pleural effusion. Computed tomography pulmonary angiography is the mainstream imaging method for detecting PE in trauma population [8].
- 4) Echocardiography: no acute right heart dysfunction; left ventricular ejection fraction 68%.
- 5) Lower extremity venous ultrasound: no deep vein thrombosis. Blunt chest trauma combined with long bone fracture can easily induce early-onset PE [9]. Occult PE is not rare in patients with lower limb fractures, which requires clinicians to stay highly alert [10].

### 2.4. Ethical Approval and Informed Consent

This retrospective case report was based on routine clinical practice without additional investigational interventions, so ethical approval was waived by West China Tianfu Hospital,

Sichuan University. Written informed consent was obtained from the patient for the publication of relevant clinical data.

## 3. Perioperative Management

### 3.1. Key Differential Diagnosis for Respiratory Abnormality

This patient had immobility, prolonged bed rest, and trauma-related hypercoagulable state, all of which indicate high PE risk. He presented with severe acute hypoxemia (room-air SpO<sub>2</sub> 75%) upon entering the operating room.

Differential diagnosis pathway:

- 1) Past medical history: long-term asthma and chronic bronchitis suggesting chronic airflow limitation.
- 2) Clinical signs: conscious, no severe chest pain or hemodynamic instability; wheezing on lung auscultation indicating airway obstruction rather than PE.
- 3) D-dimer: elevated but non-specific in trauma patients, insufficient for PE diagnosis.
- 4) Pulmonary imaging and echocardiography: chest CT and bedside ultrasound excluded acute PE, pneumothorax, and large effusion.
- 5) Arterial blood gas: compensated respiratory acidosis consistent with chronic obstructive pulmonary disease.

Final diagnosis: hypoxemia caused by acute exacerbation of uncontrolled COPD/asthma, not pulmonary embolism. Intraoperative acute saddle PE is a lethal emergency during orthopedic fracture surgery [11]. The 2019 ESC guidelines provide unified standards for the diagnosis and management of acute PE, which guides clinical practice worldwide [12].

### 3.2. Preoperative Assessment

- 1) Room-air SpO<sub>2</sub>: 75% (severe hypoxemia).
- 2) Lung auscultation: scattered wheezes in the right upper lobe.
- 3) Arterial blood gas: pH 7.422, PaCO<sub>2</sub> 49.6 mmHg, PaO<sub>2</sub> 93.0 mmHg, HCO<sub>3</sub><sup>-</sup> 31.6 mmol/L.
- 4) Chest CT: bilateral chronic pulmonary inflammation without PE, pneumothorax or large pleural effusion.
- 5) Respiratory history: confirmed long-standing asthma and chronic bronchitis.

Integrated evaluation rapidly identified undiagnosed COPD/asthma with acute bronchospasm. Retrospective studies have confirmed that comprehensive anesthetic management can reduce postoperative respiratory failure in COPD patients [13].

### 3.3. Pre-Intubation Prophylaxis for Airway Spasm

To prevent life-threatening bronchospasm during induction and intubation:

- 1) Inhaled salbutamol ( $\beta_2$  agonist) for rapid bronchodilation. Albuterol inhalation can effectively relieve hypoxia and bronchospasm in COPD patients under general anesthesia [14].
- 2) Intravenous methylprednisolone to reduce airway inflammation.
- 3) Intravenous aminophylline to improve airway function.
- 4) Airway topical anesthesia with lidocaine to reduce stimulation.
- 5) Adequate preoxygenation before anesthetic induction.
- 6) Small-dose epinephrine prepared as rescue medication for severe acute asthma or bronchospasm.

### 3.4. Intraoperative Anesthetic Management for COPD (Figure 1, Figure 2)

Anesthesia regimen: combined intravenous–inhalation an-

esthesia (propofol, remifentanyl, sevoflurane) using short-acting agents to minimize residual respiratory depression. Airway control: 7.5# reinforced endotracheal tube with gentle intubation to avoid triggering bronchospasm. Lung-protective ventilation: pressure-controlled ventilation (PCV), VT 6–8 mL/kg, PEEP 5 cmH<sub>2</sub>O, I:E 1:3–1:4 to prolong expiration and reduce auto-PEEP. For severe COPD patients undergoing orthopedic surgery, noninvasive ventilation assisted by spinal anesthesia is also an effective management mode [15]. Permissive hypercapnia: maintain PaCO<sub>2</sub> near baseline and pH  $\geq 7.20$  to avoid barotrauma and dynamic hyperinflation. Monitoring: invasive arterial pressure, serial blood gas, ETCO<sub>2</sub>, SpO<sub>2</sub>, and airway pressure; continuous bronchodilator and anti-inflammatory support as needed. Fluid and temperature: restrictive fluid strategy, active warming to prevent hypothermia-induced bronchoconstriction. In addition, general anesthesia combined with peripheral nerve block can also reduce respiratory complications in orthopedic patients [16].

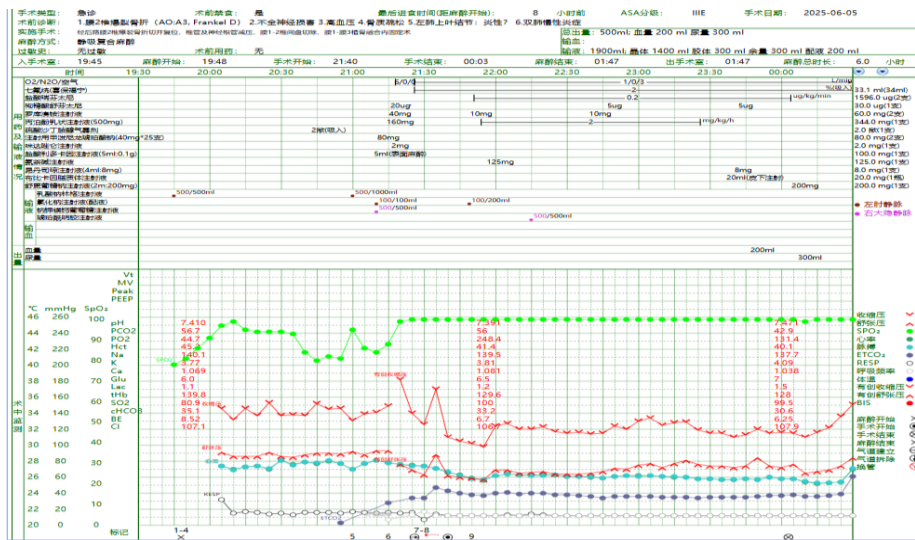


Figure 1. Anesthesia record showing key intraoperative monitoring data.

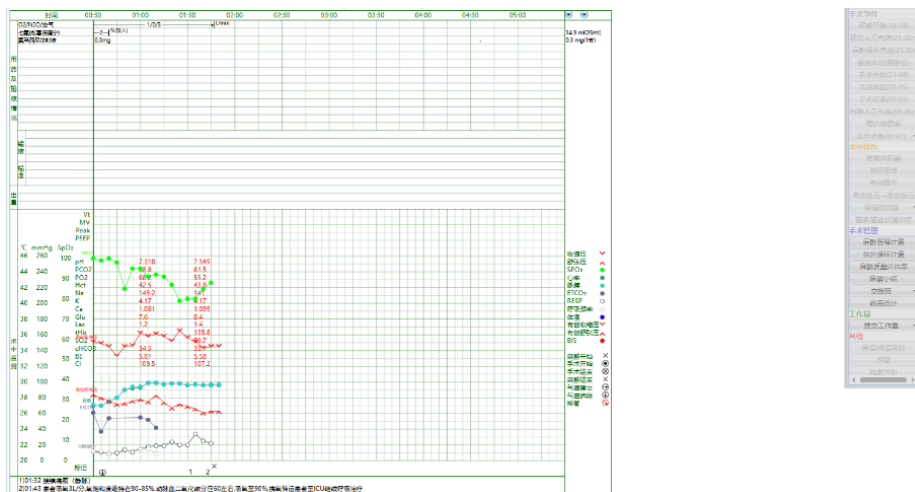


Figure 2. Anesthesia record detailing postoperative respiratory management and recovery parameters.

## 3.5. Peri-extubation Assessment and Postoperative Respiratory Care

### 3.5.1. Peri-extubation Evaluation

Extubation prerequisites: full reversal of muscle relaxation (sugammadex), clear consciousness, adequate spontaneous breathing, stable hemodynamics, and acceptable blood gas.

Pre-extubation management: gradually reduce  $\text{FiO}_2$ , maintain  $\text{SpO}_2$  88%–92%, confirm no active bronchospasm.

Goal: avoid reintubation by ensuring safe emergence without  $\text{CO}_2$  retention or respiratory failure.

### 3.5.2. Post-extubation Monitoring & Support

Immediate post-extubation: continuous ECG,  $\text{SpO}_2$ , respiratory rate, and  $\text{ETCO}_2$  monitoring; observe for dyspnea, wheezing, or hypercapnia.

Respiratory support: nasal cannula low-flow oxygen; targeted therapy for bronchospasm and  $\text{CO}_2$  retention.

ICU care: monitor  $\text{PaCO}_2$  ~60 mmHg (permissive hypercapnia),  $\text{SpO}_2$  80–85%, avoid excessive oxygenation.

Ward management: low-flow oxygen, respiratory consultation, chest physiotherapy, deep breathing exercises, and early mobilization to prevent atelectasis and respiratory failure.

Outcome: stable respiratory recovery, no reintubation, discharged on postoperative day 5.

## 4. Discussion

### 4.1. Core Clinical Reasoning

This case demonstrates the core clinical principle: orthopedic trauma patients with prolonged bed rest are at high risk of PE. When respiratory abnormalities occur, differential diagnosis must combine past medical history, signs, D-dimer, and pulmonary imaging [4, 5].

- 1) Past medical history is critical for identifying underlying chronic airway disease.
- 2) Wheezing on auscultation strongly supports obstructive lung disease rather than PE.
- 3) Elevated D-dimer in trauma is non-specific; imaging is required to confirm or exclude PE.
- 4) Integrated assessment avoids misdiagnosis and inappropriate management.

### 4.2. Key Takeaways for COPD Anesthesia

- 1) Intraoperative lung-protective ventilation with prolonged expiration and permissive hypercapnia reduces COPD-related complications [6].
- 2) Strict peri-extubation assessment prevents post-extubation respiratory distress and reintubation.
- 3) Postoperative monitoring of  $\text{CO}_2$  retention, respiratory mechanics, and early rehabilitation are essential to avoid

respiratory failure [7].

## 5. Conclusions

In immobilized orthopedic patients with acute respiratory dysfunction:

- 1) Differential diagnosis must integrate past medical history, signs, D-dimer, and pulmonary imaging to distinguish PE from chronic airway disease.
- 2) Preoperative assessment ( $\text{SpO}_2$ , auscultation, blood gas, chest CT, history) rapidly identifies occult COPD/asthma.
- 3) Pre-intubation anti-bronchospasm prophylaxis is critical for emergency anesthesia safety.
- 4) Intraoperative lung-protective ventilation and standardized peri-extubation assessment reduce bronchospasm,  $\text{CO}_2$  retention, and reintubation risk.
- 5) Postoperative respiratory monitoring and early mobilization prevent respiratory failure and ensure smooth recovery.

This comprehensive pathway significantly reduces perioperative risks and improves clinical outcomes.

## Abbreviations

ASA	American Society of Anesthesiologists
BIS	Bispectral Index
COPD	Chronic Obstructive Pulmonary Disease
CT	Computed Tomography
pH	Potential of Hydrogen
$\text{ETCO}_2$	End-tidal Carbon Dioxide
ICU	Intensive Care Unit
I:E	Inspiratory:Expiratory ratio
MRI	Magnetic Resonance Imaging
NIV	Noninvasive Ventilation
$\text{PaCO}_2$	Partial Pressure of Arterial Carbon Dioxide
$\text{PaO}_2$	Partial Pressure of Arterial Oxygen
PCV	Pressure-Controlled Ventilation
PE	Pulmonary Embolism
PEEP	Positive End-Expiratory Pressure
$\text{SpO}_2$	Peripheral Capillary Oxygen Saturation
VT	Tidal Volume

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## Author Contributions

**Yong Liu:** Conceptualization, Investigation, Methodology,

Writing – original draft, Writing – review & editing

**Mengdie Liang:** Data curation, Formal Analysis

**Feng Long:** Resources, Supervision, Validation

## Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare no conflicts of interest.

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