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# Osteosynthesis Induced Pulmonary Edema an Overview and Case Study

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## Abstract

We covered the etiology, pathophysiology, clinical manifestation, diagnosis, and classification of infection following fracture osteosynthesis with implants in the first section of the article; this illness is referred to as Osteosynthesis-Associated Infection (OAI). Generally, a prolonged course of antibiotics is required. OAI permits implant retention and fracture healing despite infection. There are five standard treatment approaches that vary based on the degree of infection, fracture healing status and host role. They are debridement with implant retention, implant removal, conversion of fixation, suppression therapy and non-operative therapy, each therapeutic pathway and its tough scenarios are explained along with the decision-making process that led to them.

**Keywords: Osteosynthesis; Implants; Infection; Pulmonary edema**

## Case Presentation

The patient is a 55-year-old female with a medical history significant for type II diabetes mellitus for 23 years, hypertension for 4 years, and chronic kidney disease necessitating hemodialysis for 2 years. Additionally, she has a history of ORIF with plate osteosynthesis. On admission, she presented with complaints of no urine output, breathing difficulty, and dry cough. Vital signs revealed a normal temperature, blood pressure of 140/90 mmHg, pulse rate of 90 beats/min, respiratory rate of 15 breaths/min, and oxygen saturation of 85%. Laboratory investigations showed inconclusive results for infection based on leukocyte count, neutrophil, eosinophil, and lymphocyte levels, but an elevated C-Reactive Protein (CRP) post-surgery suggested infection, leading to a diagnosis of acute pulmonary edema in response to infection. The treatment plan involved empirical antibiotic therapy with Inj. Cefoperazone + Sulbactam 1.5 gm, BD, gastric acid reduction with Inj. Pantoprazole 40 mg, BD, and management of blood pressure with Tab. Clonidine 0.1 mg, TDS, and Tab. Prazosin hydrochloride 2.5 mg, BD. Symptomatic relief and supportive therapy included Tab. Sodium bicarbonate 650 mg, TDS, T. Rifaximin TDS, T. Isosorbide dinitrate OD, T. Taurine and acetylcysteine BD, Tab. Calcium and Vitamin D3 TDS, T. Montelukast sodium HS, T. Bisoprolol fumarate 5 mg, OD, T. Levocarnitine 500 mg, BD, Neb. Lev salbutamol P/N, TDS, Neb. Budesonide P/N, TDS, Tab. Alprazolam 0.5 mg HS, and Inj. Paracetamol 1 gm PRN for pain. Regular monitoring and follow-up were emphasized to evaluate treatment response and adjust therapy as necessary considering the patient's complex medical history and presentation (Table 1).

## Discussion

Micromotion at the fracture site to promote bone healing while maintaining adequate blood supply. Certain fracture types, such as adolescent fractures with open growth plates and specific midshaft fractures, benefit from this approach, providing advantages like reduced risk of nonunion and malalignment compared to intramedullary nails. However, surgeons must execute plate osteosynthesis carefully to optimize micromotion and fixation strength at the fracture gap.

Osteosynthesis-Associated Infection (OAI) can occur following surgical fracture repair with internal implants. Treatment aims to eliminate infection, promote fracture healing, maintain function, and prevent recurrence. Treatment plans consider factors such as union status, time since fixation, mechanical stability, implant type, soft tissue and bone defects, joint involvement, host status, and treatment response. Referral to specialized centers may be necessary for complex cases requiring surgical intervention. Pulmonary edema, categorized as cardiogenic or non-cardiogenic as represent in Figure 1, presents distinct etiologies. Cardiogenic pulmonary edema arises from left ventricular dysfunction or valvular abnormalities, while non-cardiogenic pulmonary edema results from increased pulmonary vascular permeability due to lung injury. Understanding the

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**Table 1:** Regular monitoring and follow-up: Patient's complex medical history and presentation.

| Laboratory investigation | Day 1 | Day 2 | Day 3 | Day 4 | Reference value |
|---|---|---|---|---|---|
| White blood cell (million/ml) | 3000 | 3200 | 3450 | 3600 | 4,000-11000 million/ml |
| Neutrophils (%) | 19% | 21 | 26.5 | 32 | 40-80% |
| Basophil (%) | 0.20% | 0.3 | 0.3 | 0.4 | 0.5-1% |
| Monocyte (%) | 2% | 2 | 3 | 5 | 3-8% |
| Lymphocytes (%) | 10% | 12 | 15 | 18 | 20-40% |
| Eosinophils (%) | 1% | 1 | 1 | 2 | 1-3% |
| RBC (million/ml) | 4.4 million/ml | 4.6 | 4.65 | 4.8 | 4.5-6.0 million /ml |
| Erythrocyte sedimentation Rate (mm/h) | 90 mm/h | 70 | 65 | 40 | 0-20 mm/h |
| c-reactive protein (mg/dl) | 0.2 mg/dl | 0.2 | 0.4 | 0.6 | 0.8-1.3 mg/dl |

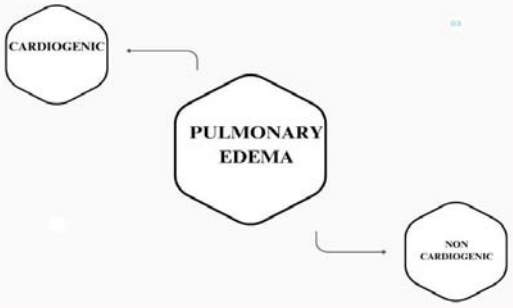


**Figure 1:** Pulmonary edema.

underlying cause is crucial for appropriate management. Infection pathophysiology involves biofilm formation on foreign material, making bacteria resistant to systemic antibiotics. Open fractures are particularly susceptible to exogenous infections during trauma, fixation device insertion, wound healing disruption, or delayed soft tissue coverage as represent in Figure 2. Polymicrobial infections are common and may require comprehensive management involving both surgical debridement and antibiotic therapy.

Surgical management aims to achieve infection control through antibiotic therapy, irrigation, debridement, and implant retention or exchange. Deep tissue cultures guide treatment decisions, with repeated debridement and vacuum therapy utilized as necessary. In severe cases, implant removal and alternative stabilization methods may be necessary to control infection.

Prevention of infection in fracture care remains challenging, with rates varying based on injury severity and patient factors. Risk factors such as male gender, diabetes, smoking, and polytrauma contribute to infection risk. While universal prevention guidelines are lacking, consensus conferences have proposed strategies focusing on soft tissue coverage, systemic, and local interventions, particularly in high-risk patients with open fractures.

In summary, plate osteosynthesis offers dynamic fixation for fractures, but careful execution is essential. Osteosynthesis-associated infections require comprehensive treatment addressing both surgical and antibiotic aspects. Understanding the etiology and pathophysiology of infections guides effective management strategies, while prevention efforts focus on mitigating known risk factors and implementing targeted interventions.

Upon initial presentation, the patient exhibited non-compliance with no urine output, concurrent breathing difficulty, and a dry cough. With a past medical history spanning twenty-three years of type II diabetes mellitus, four years of hypertension, and two years of chronic kidney disease necessitating hemodialysis, the patient's medical complexity was evident. Recently, this individual had a surgical procedure of Open Reduction Internal Fixation (ORIF) involving the use of plate, further complicating their clinical picture. In response to potential bacterial superinfection associated with hospitalization, Inj. Cefoperazone + Sulbactam was administered prophylactically. Inj. Pantoprazole was prescribed to mitigate gastric acid hypersecretion secondary to polypharmacy. Tab. Prazosin hydrochloride was initiated to manage hypertension, while Tab. Sodium bicarbonate was administered thrice daily for acid indigestion. T. Rifaximin was self-administered for bacterial infection treatment, alongside T. Isosorbide dinitrate once daily. T. Taurine and acetylcysteine were prescribed twice daily to alleviate breathing difficulties. Tab. Calcium and Vitamin D3 were provided as nutritional supplements, considering the patient's chronic kidney failure on hemodialysis. T. Montelukast sodium was administered at bedtime to alleviate breathing difficulty. To address hypertension, T. Bisoprolol fumarate was prescribed once daily. T. Levocarnitine 500 mg was initiated twice daily to address potential carnitine deficiency. Neb. Levosalbutamol P/N and Neb. Budesonide P/N were prescribed thrice daily to alleviate respiratory symptoms. Tab. Alprazolam 0.5 mg was provided at bedtime to aid sleep. The complexity of this medication regimen underscores the importance of diligent monitoring for adverse effects and interactions, necessitating careful coordination between healthcare providers. Long-term management should prioritize glycemic control, blood pressure optimization, and renal function preservation to enhance overall clinical outcomes.

## Conclusion

In conclusion, this overview and case study underscore the critical importance of remaining vigilant for Osteosynthesis-Induced Pulmonary Edema (OIPE) in orthopedic patients, particularly those undergoing procedures involving long bone fractures and intramedullary nailing. Early recognition of symptoms such as dyspnea, hypoxemia, and chest pain is essential for immediate evaluation and intervention to prevent further deterioration. Treatment strategies typically involve supportive measures like supplemental oxygen, diuretics, and mechanical ventilation, with Extracorporeal Membrane Oxygenation (ECMO) being necessary in severe cases to support gas exchange and cardiac function until pulmonary function improves. While OIPE remains a relatively rare complication, orthopedic surgeons and healthcare providers must be prepared to recognize and manage it promptly to optimize

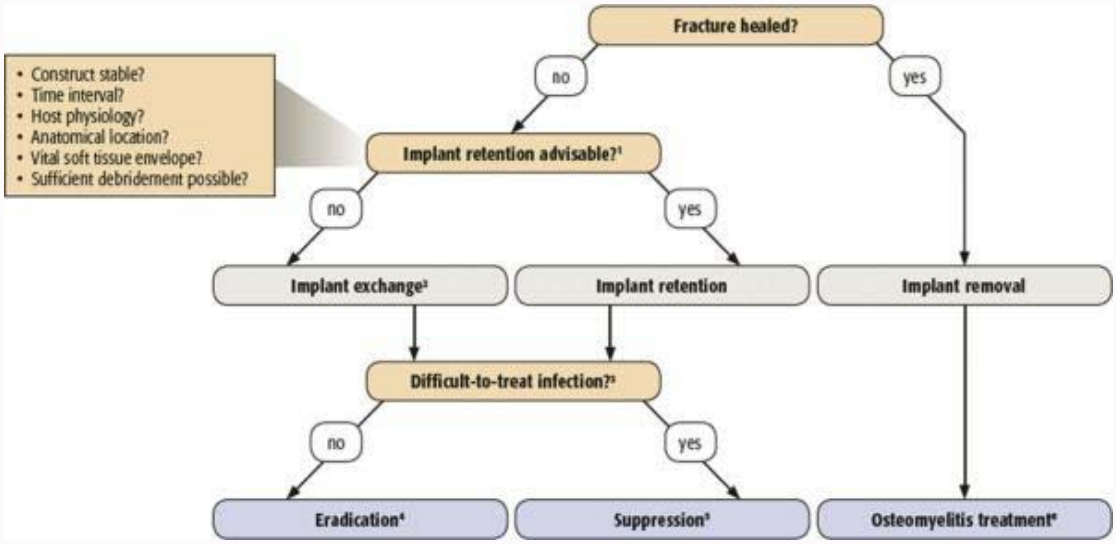


**Figure 2:** Describing the fundamental treatment principles for Fracture-Related Infection (FRI) in algorithmic form.

patient outcomes. Continued research into preventive strategies and treatment modalities is crucial to mitigate the risk and impact of OIPE Top of Form.

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