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# Bilateral Pleural Effusion as a Rare Manifestation of Snakebite Envenomation: A Case Report

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**Abstract**

**Background:**

Snakebite envenomation remains a significant global health problem, particularly in tropical regions, with a wide spectrum of clinical manifestations. While coagulopathy, neurotoxicity, and acute kidney injury are commonly reported, pleural effusion is a rare and underrecognized complication that may indicate severe systemic involvement.

**Case Presentation :**

We report a 38-year-old male with a severe snakebite in the right cervical region who developed progressive swelling, hematoma, and respiratory distress. The patient presented with dyspnea that worsened in the supine position. Physical examination revealed extensive edema involving the neck, chest, and right upper extremity. Laboratory findings showed leukocytosis, neutrophilia, and thrombocytopenia, suggesting systemic inflammation and coagulopathy. Chest radiography demonstrated right-sided pleural effusion with pulmonary infiltrates. Pleural puncture revealed hemorrhagic fluid, confirming hemorrhagic pleural effusion. The patient received comprehensive management, including antivenom therapy, antibiotics, corticosteroids, anticoagulant support, and pleural drainage, resulting in clinical improvement

**Conclusion** :

Pleural effusion, particularly **hemorrhagic** type, should be recognized as a potential manifestation of severe snakebite envenomation. Early identification and appropriate management are essential to prevent clinical deterioration and improve patient outcomes.

**Keywords: Snakebite, Envenomation, Hemorrhagic Pleural Effusion, Coagulopathy, Respiratory Complications.**

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## Introduction

Snakebite envenomation continues to be a major public health issue worldwide, particularly in tropical and subtropical regions. According to the World Health Organization, it accounts for tens of thousands of deaths annually. Southeast Asia, including Indonesia, is considered a high-risk region due to the diversity of venomous snake species. However, the true burden in Indonesia remains underestimated due to limited reporting systems. The clinical manifestations of snakebite vary widely, depending on the species, venom composition, and individual susceptibility. Envenomation can cause local tissue damage such as pain, edema, and necrosis, as well as systemic complications including venom-induced consumption coagulopathy (VICC), neurotoxicity, and organ dysfunction involving the kidneys, heart, and muscles Suliman et al., 2024;WHO, 2019;Yuniasih, 2022).

Respiratory involvement in snakebite, although less commonly emphasized, has important clinical implications. Reported manifestations include non-cardiogenic pulmonary edema, acute respiratory distress syndrome (ARDS), and

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alveolar hemorrhage. However, pleural effusion remains a rare and underreported complication. Its pathophysiology is thought to involve endothelial dysfunction, increased vascular permeability, protein leakage, and coagulopathy. This case report aims to highlight pleural effusion as a manifestation of systemic envenomation and to discuss its underlying mechanisms. (Seifert, 2022; WHO 2019).

This case is notable due to the occurrence of pleural effusion following a cervical snakebite, which represents a high-risk anatomical location for rapid systemic dissemination of venom. Unlike previously reported cases that primarily describe pulmonary edema or ARDS, this report highlights pleural effusion as a clinically significant but underrecognized manifestation of envenomation. Furthermore, this case emphasizes the correlation between clinical presentation, laboratory abnormalities, and radiological findings, providing a more comprehensive understanding of pleural involvement in snakebite ( Gutiérrez et al., 2017; Jadoon et al., 2025).

## Case Presentation

A 38-year-old male patient presented with a chief complaint of pain in the right neck region following a snakebite incident and referred with a diagnosis of snakebite in the right neck region grade III. The patient complained of pain in the right neck after bitten by a green snake with a red tail while working in the garden several hours before hospital admission. The pain felt like stabbing with a VAS intensity of 5/10, radiating to the upper right arm to the right chest, and was accompanied by swelling in the right neck, chest, and right arm.

Shortly after the incident, the patient was brought to the nearest healthcare facility. As his condition progressed, he experienced a loss of consciousness, then developed shortness of breath, and swelling that spread to his face, neck, chest, and right arm. After initial management, the patient was referred to a tertiary hospital for further treatment.

Currently, the patient still complains of shortness of breath that worsens when lying down and improves with a semi-sitting position. Furthermore, the patient complains of nausea without vomiting. There are no complaints of headache, fever, dizziness, weakness of the limbs, or cramps. There is no history of medication before admission, while previous therapy during the hospitalization was given Ketorolac injection, diphenhydramine injection, and Paracetamol. On inspection, edema was noted in the right neck, chest, shoulder, and right arm. The patient has no previous history of illnesses such as hypertension, asthma, or diabetes mellitus.

### Physical examination

On physical examination, the patient appeared moderately ill with stable vital signs. Conjunctivae were not anemic and sclerae were non-icteric. Examination of the neck and right upper body revealed extensive edema involving the right cervical region, extending to the chest, shoulder, and upper extremity. Distinct fang marks were observed on the right side of the neck, accompanied by hyperemia and ecchymosis. Palpation elicited tenderness and swelling in the affected areas.

Chest examination showed symmetrical chest wall movement with decreased percussion notes on the right hemithorax. On auscultation, vesicular breath sounds were present with additional rhonchi on the right side, without wheezing. Abdominal examination was unremarkable, with normal bowel sounds and no tenderness. Extremities were warm with normal capillary refill time, although localized edema was noted in the right upper limb.

### Supporting investigation

Laboratory investigations revealed marked leukocytosis (22,430/µL) with predominant neutrophilia (81.9%), indicating a significant systemic inflammatory response. Thrombocytopenia (70,480/µL) was also observed, suggesting possible venom-induced consumption coagulopathy. Hemoglobin and other red blood cell indices were within normal limits. These findings support the presence of systemic envenomation with associated inflammatory and hematological disturbances, which may contribute to increased vascular permeability and the development of pleural effusion. Detailed laboratory parameters are provided in Supplementary Table 1.

**Table 1** Complete Laboratory Findings of the Patient

| Test name | Results | Unit | Normal Values |
|---|---|---|---|
| Hemoglobin | 12.6 | g/dL | 12.0 - 16.0 |
| **Leukocytes** | **22430** | **/uL** | **4000 -10000** |
| Erythrocytes | 4.23 | million/µL | 3.50 - 5.00 |
| **Platelets** | **70480** | **/uL** | **150000 -400000** |
| Hematocrit | 39 | % | 36 - 48 |
| MCV | 91.8 | fL | 80.0 -100.0 |
| MCH | 29.8 | pg | 26.0 - 34.0 |
| MCHC | 32.5 | g/dL | 32.0 - 36.0 |
| **RDW-SD** | **12.4** | **fL** | **35.0 - 47.0** |
| **PDW** | **21.0** | **fL** | **9.0 - 13.0** |
| MPV | 8.0 | fL | 7.2 - 11.1 |
| **PCT** | **0.06** | **%** | **0.15 - 0.40** |
| Basofil | 0.7 | % | 0.0 - 1.0 |
| **Eosinophil** | **0.0** | **%** | **1.0 - 26.0** |
| **Neutrophil** | **81.9** | **%** | **50.0 - 70.0** |
| **Lymphatic drainage** | **4.7** | **%** | **20.0 - 40.0** |
| **Monosit** | **12.7** | **%** | **2.0 - 8.0** |

### Radiologists

Chest radiography revealed right-sided pleural effusion, characterized by blunting of the right costophrenic angle and homogeneous opacity in the lower lung zone. In addition, a patchy paracardial infiltrate was observed, suggesting a possible concurrent pulmonary infection. These findings support pleural involvement as part of systemic envenomation.

**Figure 1.** Chest radiograph demonstrating right pleural effusion and associated pulmonary infiltrate, consistent with pleural involvement in snakebite envenomation.

**Pleural Intervention**

Pleural puncture revealed hemorrhagic fluid, with approximately 600 mL of blood-tinged fluid evacuated from the pleural cavity, indicating hemorrhagic pleural effusion likely associated with underlying coagulopathy and venom-induced vascular injury. A chest tube was subsequently inserted for continuous pleural drainage. Following the procedure, adequate drainage was achieved, as evidenced by positive fluid fluctuation and continued fluid output. No air leak was observed, and there were no signs of subcutaneous emphysema or active bleeding, indicating proper chest tube function without immediate complications.

**Management**

The patient received comprehensive and multidisciplinary management, including intravenous fluid resuscitation with Ringer's lactate and administration of antivenom serum as the primary therapy. Broad-spectrum antibiotics, including ceftriaxone and moxifloxacin, were initiated to manage suspected pneumonia. Corticosteroids and antihistamines were administered to mitigate inflammatory responses and potential allergic reactions. Supportive care included analgesics, gastric protection, and oxygen therapy to maintain adequate oxygenation. In view of the underlying coagulopathy, the patient was treated with tranexamic acid, vitamin K, and platelet transfusion. Additionally, diuretic therapy was given to assist in fluid balance management. This comprehensive management approach contributed to the patient's clinical improvement and stabilization.

**Clinical Diagnosis**

- Severe snakebite envenomation in the right cervical region (suspected green viper)
- Suspected disseminated intravascular coagulation
- Thrombocytopenia
- Right-sided pleural effusion
- Community-acquired pneumonia

These diagnoses were established based on clinical presentation, laboratory findings, and radiological evaluation.

## Discussion

**Clinical Case Overview**

This case describes a patient with a severe snakebite in the right cervical region who subsequently developed systemic manifestations, including progressive dyspnea and extensive edema. Snakebites involving the cervical region are considered high-risk due to the rich vascular supply and proximity to vital structures, allowing rapid dissemination of venom into the systemic circulation. This differs from envenomation in the extremities, which typically demonstrates a slower clinical progression (Warrell, 2019; WHO, 2019).

The presence of radiating pain from the neck to the right upper limb and chest suggests the spread of venom through soft tissue, lymphatic, and vascular pathways. The progressive edema and hematoma observed in this patient reflect the vasculotoxic effects of snake venom, particularly in viper envenomation, which is characterized by endothelial damage and increased vascular permeability (Gutiérrez et al., 2021).

Respiratory involvement in this case is indicated by worsening dyspnea, particularly in the supine position, which improved with a semi-upright posture. This clinical presentation suggests increased intrathoracic pressure, most likely due to pleural effusion. Such positional dyspnea is a typical manifestation of pleural fluid accumulation and should raise suspicion for pleural involvement in patients with systemic envenomation (Light, 2021).

The development of pleural effusion in snakebite is rare but can be explained by several pathophysiological mechanisms. Snake venom contains active components such as metalloproteinases and phospholipase A2, which contribute to endothelial injury and increased capillary permeability. This process leads to capillary leak syndrome, allowing fluid to accumulate in interstitial tissues and body cavities, including the pleural space (Gutiérrez et al., 2021; Slagboom et al., 2020). This finding is consistent with previous studies that identify vascular permeability as a key mechanism in severe envenomation (Guamán-Charco et al., 2025).

In addition, coagulation disturbances play a significant role in the development of pleural effusion. Thrombocytopenia and suspected disseminated intravascular coagulation in this patient suggest venom-induced consumption coagulopathy. This condition can lead to bleeding into the pleural cavity, resulting in hemorrhagic effusion, which further exacerbates respiratory compromise (Warrell, 2019).

The presence of hemorrhagic pleural fluid in this patient further supports the role of coagulation disturbances in the pathogenesis of pleural effusion. Pleural puncture demonstrated blood-tinged fluid, indicating hemorrhagic effusion consistent with venom-induced consumption coagulopathy. In addition to increased vascular permeability, bleeding into the pleural space may contribute to fluid accumulation and worsening respiratory compromise.

The use of chest tube drainage in this case provided effective fluid evacuation and clinical stabilization, as indicated by adequate drainage without evidence of air leak or procedure-related complications. This supports the role of timely pleural intervention in managing respiratory compromise associated with severe envenomation.This highlights the importance of pleural fluid evaluation and appropriate drainage procedures in snakebite patients presenting with respiratory symptoms, as it may reveal and address underlying hemorrhagic complications.

Laboratory findings in this case demonstrated leukocytosis with predominant neutrophilia, indicating a systemic inflammatory response. This inflammatory process contributes to endothelial dysfunction and increased vascular permeability, further supporting the development of pleural effusion. These findings are consistent with the concept that pleural involvement in snakebite is part of a broader systemic inflammatory and vascular response (Silva et al., 2021).

Radiological examination confirmed right-sided pleural effusion accompanied by pulmonary infiltrates suggestive of pneumonia. The coexistence of infection may further aggravate pulmonary inflammation and vascular permeability, thereby accelerating fluid accumulation in the pleural space (Light, 2021; Jadoon et al., 2025).

This case highlights pleural effusion as an uncommon but clinically significant manifestation of snakebite envenomation, which may be underrecognized in routine clinical practice. The combination of clinical symptoms, laboratory abnormalities, and radiological findings underscores the importance of a comprehensive diagnostic approach in patients with severe envenomation.

Clinicians should be aware of potential respiratory complications in snakebite patients, particularly in high-risk anatomical locations such as the cervical region. Early recognition of pleural involvement and prompt management are essential to prevent clinical deterioration and improve patient outcomes.

**Figure 2.** Swelling extending from the right cervical region to the chest and upper extremity, indicating extensive soft tissue involvement.

**Figure 3.** Clinical photograph demonstrating extensive edema and ecchymosis in the right cervical region with visible fang marks, consistent with severe local envenomation.

**Pathophysiology of Pleural Effusion in Snake Bite Cases**

Snake venom contains various active components, such as metalloproteinases, phospholipase A2, and other proteolytic enzymes, that have a direct effect on blood vessel structure. Metalloproteinases play a role in damaging the extracellular matrix and vascular endothelium, while phospholipase A2 damages cell membranes and triggers an inflammatory response. This damage results in increased capillary permeability, allowing plasma fluid to leak from the intravascular space into the interstitial tissue and body cavities, including the pleural cavity (Gutiérrez et al., 2021; Slagboom et al., 2020).

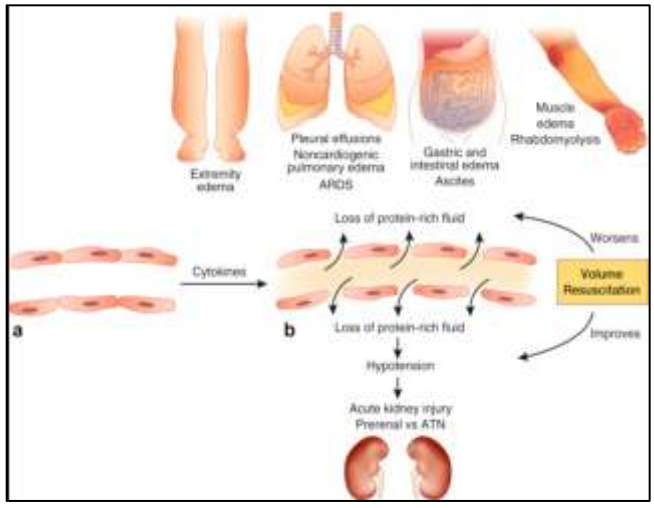


**Figure 4.** Pathophysiology of Pleural Effusion in Snake Bites (Udayabhaskaran et al., 2017)

The primary mechanism underlying this condition is capillary leak syndrome, a condition characterized by widespread fluid leakage due to impaired vascular integrity. In this condition, fluid accumulates not only in soft tissues but can also fill the pleural cavity and other body cavities. This explains why snakebite patients often have extensive edema

accompanied by pleural effusion or ascites. Capillary leak syndrome is an important indicator of severe envenomation with systemic involvement (Chippaux, 2022; Udayabhaskaran et al., 2017).

Furthermore, snake venom disrupts the hemostatic system through the consumption of coagulation factors and decreased fibrinogen levels. Uncontrolled coagulation activation can lead to conditions resembling disseminated intravascular coagulation (DIC), leading to systemic bleeding. In this context, pleural effusion can occur in the form of hemorrhage or hemothorax due to blood leakage into the pleural cavity. This mechanism worsens the patient's clinical condition and increases the risk of respiratory complications (Warrell, 2019).

Therefore, in this case, pleural effusion results from a complex interaction between direct toxic effects, coagulation disorders, and the systemic inflammatory response. These three mechanisms operate simultaneously and mutually exacerbate the patient's clinical condition. Therefore, understanding this pathophysiology is crucial for determining the appropriate diagnostic and management approach (Chippaux, 2022; Gutiérrez et al., 2021).

**Relationship between Clinical Manifestations and Pleural Effusion**

The patient's symptoms of shortness of breath are characteristically worse in the supine position and improved in the semi-Fowler's position. This condition indicates impaired respiratory mechanics due to increased intrathoracic pressure. In pleural effusion, fluid accumulation in the pleural cavity compresses the lungs, reducing their capacity for expansion and causing shortness of breath. A semi-sitting position helps relieve this pressure, thus relieving symptoms (Light, 2021).

Extensive edema involving the neck, chest, and right arm indicates significant systemic capillary leak. This condition not only causes soft tissue swelling but also allows fluid to accumulate in the pleural cavity. This supports the possibility that the pleural effusion in this patient is part of a manifestation of capillary leak syndrome. The more extensive the edema, the greater the likelihood of involvement of body cavities, including the pleura (Silva et al., 2021).

Hematomas found in patients indicate coagulation disorders that can contribute to the formation of hemorrhagic pleural effusions. In severe envenomation, impaired hemostasis can lead to spontaneous bleeding, including into the pleural cavity. This worsens the patient's respiratory condition because not only does the fluid compress the lungs but also the presence of blood components that increase the viscosity of the pleural fluid (Slagboom et al., 2020).

Furthermore, bites in the neck region have a significant clinical impact on the respiratory system. Edema in this area can cause upper airway compression, impairing ventilation. The combination of airway obstruction and pleural effusion can cause severe respiratory distress and increase the risk of respiratory failure. Therefore, patients with bites in the neck region require closer respiratory monitoring (Warrell, 2019).

Thus, the clinical manifestations in this patient are highly consistent with pleural involvement as part of a systemic complication of snakebite. The relationship between clinical symptoms and pathophysiology suggests that pleural effusion is not an isolated finding, but rather part of the spectrum of severe envenomation (Guamán-Charco et al., 2025).

**Supporting Examination Results**

In this case, laboratory tests revealed leukocytosis (22,430/µL) with a predominance of neutrophils (81.9%), indicating a significant systemic inflammatory response. This condition can be caused by the direct effects of snake venom toxins or a secondary response to tissue damage. Leukocyte activation, particularly neutrophils, plays a role in the release of inflammatory mediators such as proinflammatory cytokines that increase vascular permeability. This mechanism contributes to capillary leak syndrome, which is one of the main mechanisms for the formation of pleural effusion in snake envenomation (Silva et al., 2021; Gutiérrez et al., 2021).

Furthermore, thrombocytopenia (70,480/µL) was found, indicating impaired hemostasis, suggesting venom-induced consumption coagulopathy (VICC) or even disseminated intravascular coagulation (DIC). This condition results in excessive consumption of platelets and coagulation factors, increasing the risk of systemic bleeding. This is relevant to the clinical findings of hematoma in the patient and has the potential to cause hemorrhagic pleural effusion due to blood leakage into the pleural cavity. Coagulation disorders are a key characteristic of hemotoxic viper envenomation (Slagboom et al., 2020; Warrell, 2019).

Radiologically, a chest X-ray revealed a right pleural effusion accompanied by a patchy right paracardial infiltrate suggestive of pneumonia. This pleural effusion confirmed pleural cavity involvement as part of a systemic complication. Meanwhile, pneumonia can worsen respiratory conditions and increase pulmonary vascular permeability through local inflammation. The combination of pulmonary inflammation and systemic toxins can accelerate fluid accumulation in the pleural cavity (Light, 2021; Jadoon et al., 2025).

**Management of Pleural Effusion in Snakebite**

Management of pleural effusion in snakebite must be comprehensive, combining causative and supportive therapy. The primary therapy is the administration of antivenom, which neutralizes toxins circulating in the body. Early administration of antivenom has been shown to reduce the progression of tissue damage and prevent more severe systemic complications. Therefore, this therapy is a key pillar in snakebite management (WHO, 2019; Warrell, 2019).

Airway management is a top priority, especially in cases where the bite is located in the neck region, as in this patient. Edema in the neck area can cause upper airway obstruction, requiring close monitoring of respiratory status. Oxygen administration, semi-Fowler's position, and readiness for airway interventions such as intubation should be considered. Prompt and appropriate management of these aspects is crucial to prevent respiratory failure.

In this case, the patient underwent pleural fluid evacuation through a chest tube procedure. This procedure involves the placement of a chest tube (tube thoracostomy) to allow continuous evacuation of fluid from the pleural space, thereby reducing intrathoracic pressure and facilitating lung re-expansion. Compared to thoracentesis, chest tube drainage is more appropriate in cases of large, recurrent, or complicated pleural effusions that require ongoing fluid removal. In addition to its therapeutic benefit, this intervention also enables pleural fluid sampling for diagnostic evaluation to determine the underlying etiology of the effusion. Current evidence suggests that chest tube insertion is indicated in patients with clinically significant and symptomatic pleural effusion, particularly when there is rapid re-accumulation or associated complications (Porcel, 2023).

However, pleural drainage in snakebite patients requires caution, especially in patients with coagulation disorders such as thrombocytopenia or suspected DIC. The risk of bleeding must be considered before the procedure is performed, so evaluating coagulation parameters is crucial in determining the safety of the procedure. In this case, the presence of thrombocytopenia indicates the need for increased vigilance during invasive procedures (Guamán-Charco et al., 2025).

Fluid therapy is also necessary given the risk of capillary leak syndrome, which can worsen edema and pleural effusion. Excessive fluid administration can increase fluid accumulation in the pleural cavity and interstitial tissue. Therefore, close monitoring of fluid balance is essential to maintain hemodynamic stability without worsening the patient's clinical condition (Silva et al., 2021).

Furthermore, management also includes addressing other complications such as coagulation disorders, secondary infections like pneumonia, and another organ dysfunction. A multidisciplinary approach is essential to ensure optimal treatment. Overall, the principles of snakebite management include causative therapy, supportive therapy, and comprehensive management of complications (WHO, 2019).

## Conclusion

This case demonstrates that a snakebite in the right neck region can progress to severe systemic envenomation with multisystem involvement, including the respiratory system. Clinical manifestations include progressive local pain, extensive edema, hematoma, and position-dependent shortness of breath, suggesting the possibility of intrathoracic complications such as pleural effusion. The bite's proximity to the airway and major blood vessels plays a crucial role in accelerating toxin distribution, increasing the risk of severe systemic complications.

Snakebite in the cervical region can lead to severe systemic envenomation with respiratory involvement. Pleural effusion, although rare, should be recognized as a potential complication associated with increased vascular permeability, coagulopathy, and systemic inflammation.

Early diagnosis and prompt management, including antivenom therapy and supportive care, are crucial to prevent deterioration and improve clinical outcomes. Clinicians should maintain a high index of suspicion for pleural involvement in patients presenting with respiratory symptoms following snakebite.

## Limitation

This case report has several limitations. First, detailed information regarding the patient's prior medical interventions, particularly related to previous thoracic procedures, was limited, which may affect the comprehensive assessment of the patient's baseline condition.

Second, the absence of pleural fluid analysis restricts further characterization of the effusion, including differentiation between transudative and exudative processes, as well as the possibility of hemorrhagic involvement.

Third, as a single case report, the findings may not be generalizable to all snakebite cases, particularly given the variability in venom composition and individual patient responses.

Despite these limitations, this case provides valuable insight into a rare manifestation of snakebite envenomation and highlights the importance of recognizing atypical complications.

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