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CASE REPORT

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Diagnosis of pulmonary lophomoniasis in an elderly anthracosis patient with resistant respiratory symptoms: A literature review and a case report study

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Key Clinical Message

Anthracosis causes chronic lung inflammation and immunodeficiency, which are associated with parasitic conditions like lophomonas. Healthcare providers must consider both anthracosis and pulmonary lophomoniasis when evaluating patients with respiratory symptoms, as early detection and treatment can lead to better outcomes for affected individuals. Proper diagnosis and management of these conditions can help prevent complications and improve overall lung health.

Abstract

Anthracosis is a chronic pulmonary disease characterized by black pigmentation of the bronchial mucosa due to carbon accumulation in the lungs. This condition can result in immunosuppression and make patients more susceptible to parasitic diseases. A 77-year-old patient was admitted with fever, dyspnea, and cough with whitish-yellow sputum that began 2 months ago. Symptoms worsened with partial response to outpatient treatment. Bronchoscopy was requested due to abnormal lab tests and CT scan findings. Bronchoscopy sample revealed anthracosis and microscopic analysis of BAL detected live oval flagellated lophomonas protozoa. Treatment consisted of bronchodilators, corticosteroids, and antibiotic therapy. Anthracosis is linked to parasite diseases, such as lophomonas; thus, concurrent pulmonary lophomoniasis should be considered when anthracosis is identified. Healthcare providers must be vigilant in diagnosing and treating both anthracosis and pulmonary lophomoniasis, as the presence of one may indicate the possibility of the other.

KEYWORDS

anthracosis, *Lophomonas blattarum* infection, lophomoniasis, parasite disease

1 | INTRODUCTION

Anthracosis is the asymptomatic, mild form of pneumoconiosis caused by carbon accumulation in the lungs from repeated exposure to air pollution or inhaling smoke or coal dust particles. Cough and dyspnea are the most critical symptoms of anthracosis in most patients. In severe cases, anthracosis can lead to respiratory complications such as chronic bronchitis, enlarged mediastinal lymph nodes such as vocal cord paralysis, broncho-lithiasis, or even respiratory failure.[1,2]

Studies reported a strong association with diseases such as chronic obstructive pulmonary disease (COPD), parasite disease, tuberculosis, and lung cancer. Routine check-ups can help monitor the progression of anthracosis and prevent further complications.[2,3]

Empirical treatments such as bronchodilators (short or long-acting), corticosteroids (inhalation or systemic), and antibiotics have been utilized. Other supportive measures like oxygen therapy and chest physiotherapy may also be considered depending on the severity of the condition.[4,5]

Lophomonas blattarum (*L. blattarum*) is an uncommon protozoan parasite discovered in the intestines of arthropods, including cockroaches and termites. *L. blattarum*, categorized as an opportunistic pathogen, can lead to bronchopulmonary infections, particularly in individuals with compromised immune systems. This protozoan is typically spread through waste and dust when the host is in motion. It has the capacity to invade multiple tissues such as the sinuses, reproductive system, and respiratory system in humans. Clinical manifestations are typically nonspecific and include symptoms like cough, production of sputum, fever, chest discomfort, and respiratory distress.[6,7]

Lophomonas blattarum infections are often underdiagnosed due to the nonspecific symptoms it presents. Diagnosis can be challenging and typically involves identifying the parasite in respiratory secretions or tissue samples. Treatment usually consists of metronidazole or tinidazole medications, although treatments' effectiveness can vary. Prevention of *L. blattarum* infections involves controlling the arthropod populations in living areas and maintaining good hygiene practices.[8,9]

Several cases of lophomonas infection in patients with immunocompromised conditions and other underlying diseases have been reported to date. However, there is no evidence of infection of lophomonas in anthracosis patients worldwide. The presence of lophomoniasis in anthracosis patients may lead to increased inflammation, impaired lung function, and a higher risk of respiratory infections. This combination can potentially exacerbate respiratory symptoms and complications in affected individuals. Healthcare providers must consider both anthracosis and lophomoniasis when evaluating individuals with respiratory symptoms, especially those exposed to coal dust or living in environments where cockroaches are prevalent.[10,11] This research discusses the diagnosis and treatment of a 77-year-old man who was found to be infected with both lophomonas and anthracosis. The case highlights the importance of considering multiple infectious agents in patients with complex medical histories and symptoms.

2 | CASE PRESENTATION

2.1 | Medical history and examination

A 77-year-old patient was referred to our center in Gorgan, Iran. He presented with shortness of breath, cough with whitish-yellow sputum, chills, and fever that began 2 months ago. His symptoms worsened over the past week and did not fully resolve with outpatient treatment. Upon admission, the patient reported weakness, chest pain, and frequent fatigue over the past 2 months, with no history of hemoptysis.

The patient had a medical history of diabetes, chronic obstructive pulmonary disease (COPD), and hypertension. His vital signs were stable during the physical examination, and his oxygen saturation level was 92% without needing for supplemental oxygen therapy. He had function class 2 dyspnea. Respiratory crackles were heard during auscultation, and heart sounds (S1 and S2) were regular. Abdominopelvic examination revealed no abnormalities, and there were no signs of splenomegaly, lymphadenopathy, or hepatomegaly.

2.2 | Method (Differential diagnosis, investigations, and treatment)

The patient's respiratory infection symptoms did not improve with outpatient treatment, and due to the persistence of symptoms and abnormal examination findings, hospitalization was necessary. Initial evaluation included laboratory tests and chest X-rays, revealing a pleural effusion with patchy consolidation in the right lobe (Figure 1A). The hemogram showed anemia and leukocytosis, ESR was 44 mm/s, and CRP concentration was +2. Consultation was sought from a pulmonologist and an infection specialist. Additional tests, including spiral computed tomography (CT) scans, were conducted due to rising inflammatory markers, leukocytosis, and abnormal X-ray results.

Levels of perinuclear antineutrophil cytoplasmic antibodies (P-ANCA) in serum, cytoplasmic antineutrophil

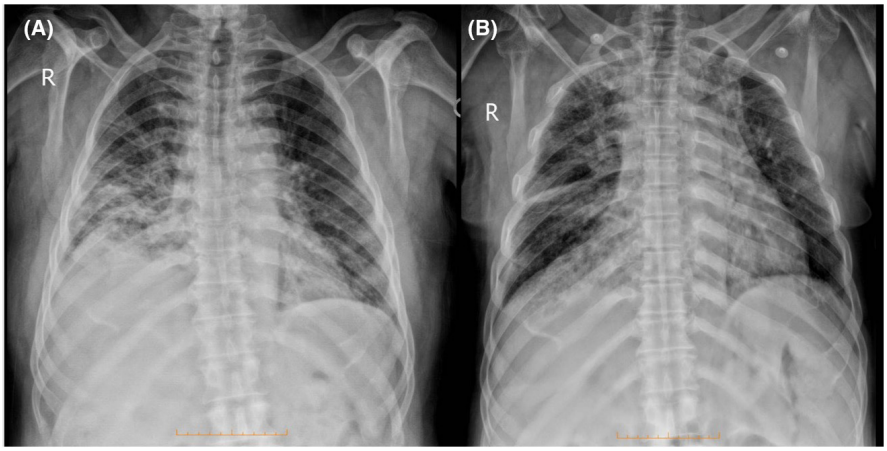

FIGURE 1 (A) Initial chest X-ray. It shows pleural effusion with patchy consolidation in the right lobe. (B) A follow-up chest X-ray taken 2 weeks after initiating treatment showed improvement in pleural effusion and consolidation.

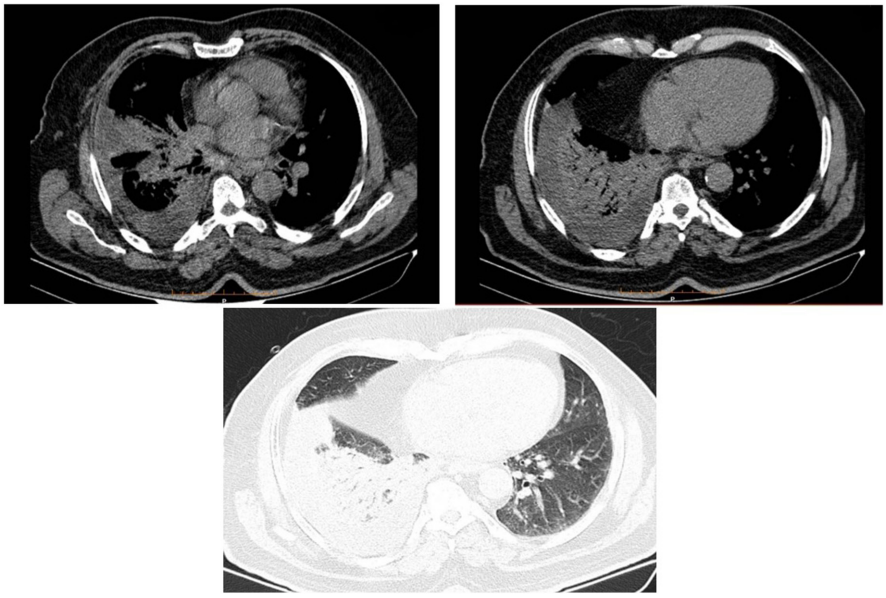

FIGURE 2 A lung and mediastinal computed tomography scan shows consolidation and patchy ground-glass opacity of the right lobe. In addition, air bronchogram and peribronchial cuffing along with moderate right pleural effusion were observed.

cytoplasmic antibody (C-ANCA), and viral markers (the human immunodeficiency virus, hepatitis B, and hepatitis C) were within normal limits. The galactomannan test yielded a negative result. Additionally, given the current circumstances surrounding the COVID-19 outbreak, a SARS-CoV-2 polymerase chain reaction (PCR) test was administered and the results came back negative. An investigation of fungal infection with a serum galactomannan test was also ordered, and the result was negative.

A cardiology consultant was ordered for the patient. The electrocardiography revealed mild left ventricular hypertrophy, ejection fraction of 50%, moderate mitral regurgitation, and tricuspid regurgitation with no pericardial effusion.

The spiral CT scan of the lungs revealed consolidation and patchy ground-glass opacity in the right upper lobe and right lower lobe. Also, air bronchogram and peribronchial cuffing were reported in both lobes. The patient had a moderate right pleural effusion (550 cc) (Figure 2). A chest tube was performed, and the laboratory result was exudative with gram-positive cocci infection. In addition, procalcitonin was negative, and the adenosine deaminase level (38.8 μ/L) was within the normal range.

Due to an abnormal lung CT scan, a fiber optic bronchoscopy was ordered for the patient (Figure 3). A bronchoalveolar lavage (BAL) specimen was collected to assess BK (Bacillus of Koch), lophomonas, bacterial and fungal infections. Moreover, observing the black discoloration of mucosa during bronchoscopy led to the patient's anthracosis diagnosis.

Fungal and bacterial infections were not detected in the BAL samples. Microscopic examination of BAL showed multiple live and oval flagellated lophomonas protozoa (Figure 4).

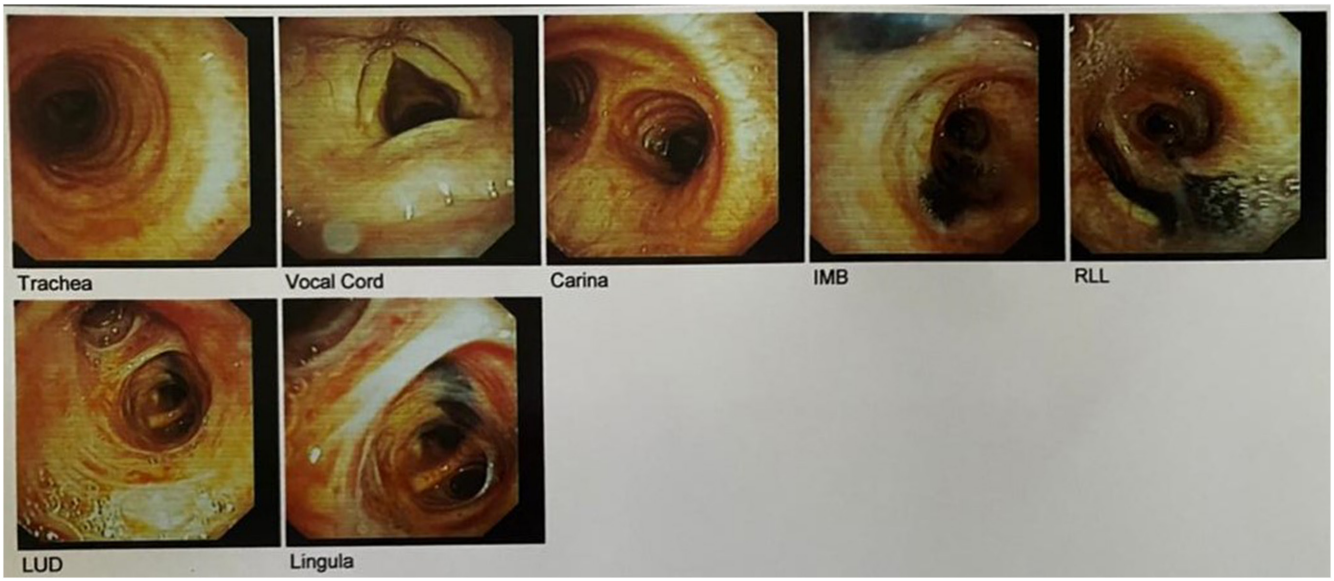

FIGURE 3 The bronchoscopic finding of the patient. It shows black pigmentation and discoloration of the mucosa.

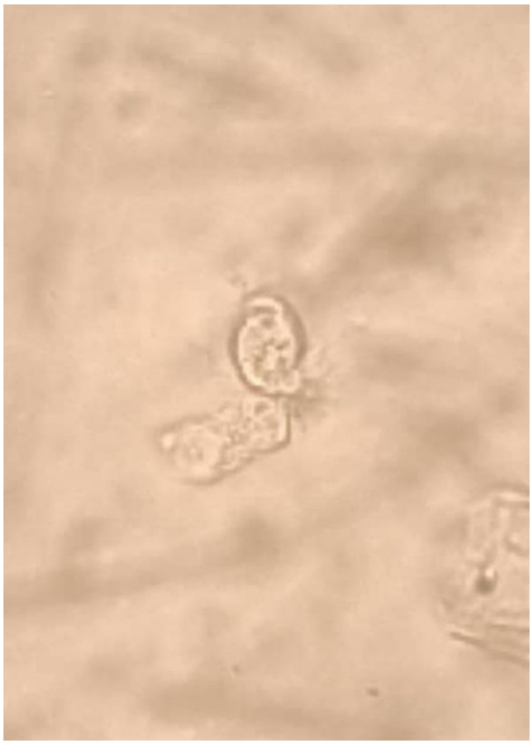

FIGURE 4 A microscopic analysis of the bronchoalveolar lavage (BAL) revealed the presence of viable and oval-shaped lophomonas protozoa with flagella.

2.3 | Conclusion and Results (Outcome and follow-up)

Based on the positive BAL result and anthracosis pattern in bronchoscopy, the patient was diagnosed with anthracosis and active pulmonary lophomonas infection. Treatment included antibiotics (including metronidazole 500 mg every 8 h), bronchodilators, and corticosteroids have been used. The patient was discharged with oral medication instructions, had good overall health, and had improved clinical symptoms. After 2 weeks of treatment, the effusion resolved, and the chest imaging improved (Figure 1B).

3 | DISCUSSION

Anthracosis causing destruction and deformation of the bronchi is termed anthracofibrosis, an occupational disease. Although anthracofibrosis is reduced in Western industrial countries, it is still widespread in some third-world countries. The severity of anthracosis can vary depending on the duration and intensity of exposure to the particles.[1–3] The diagnosis of anthracosis is typically made through imaging studies (chest X-rays and CT scans), which can show characteristic findings such as linear or nodular opacities in the lungs.[2,3] Bronchoscopy is the gold standard for diagnosing anthracosis. Anthracosis may be detected in different images as simple flat anthracosis, deep-seated retracted anthracosis (originating from an anthracitic lymph node beside the bronchus), and protruded black discoloration of mucosa with or without narrowing of bronchi. In addition to black lesions, bronchial swelling with infiltration, erythema, and thickening that may cause obliteration of bronchi may be seen. Bronchoscopy allows for direct visualization of the bronchial mucosa and the collection of biopsy samples for further analysis. It is a valuable tool in diagnosing and managing anthracosis, providing

vital information for treatment planning and monitoring of the disease progression.[4,5]

Treatment of anthracosis usually involves avoiding further exposure to coal dust and managing symptoms such as cough and shortness of breath. In more severe cases of anthracofibrosis, interventions such as bronchoscopic procedures or surgery may be necessary to relieve airway obstruction.[2,5]

Clinically significant pulmonary protozoan infections are uncommon but have become more acknowledged due to compromised immune states in recent years. Several research studies have indicated that several factors may impact the occurrence of parasitic diseases and anthracosis in individuals, such as socio-demographic characteristics (such as gender and age), pre-existing medical conditions, and living in areas where anthracosis and parasitic infections are more prevalent. Additionally, studies have documented cases of co-infection or superinfection of lophomoniasis in individuals with underlying health issues.[7] In our study, the patient had diabetes, which could affect the immune system and lead to immunosuppression. This may have contributed to the patient's increased susceptibility to infections.

Lophomonas represents a genus of unicellular flagellated protozoa that predominantly inhabit the digestive tract of termites. These organisms are commonly acknowledged as symbiotic entities residing within the hindgut of termites. Distinguishing *Lophomonas blattarum* from ciliated epithelial cells solely based on morphological characteristics under a light microscope can pose challenges, potentially leading to misdiagnoses. Therefore, employing techniques such as bronchoscopy biopsy smear, sputum smear, or bronchoalveolar lavage (BAL) can facilitate the identification of *L. blattarum* in patients. Infections attributed to *L. blattarum* typically manifest with atypical and nonspecific clinical symptoms, predominantly impacting the respiratory system and likely being transmitted through airborne routes.[7–9] These infections exhibit resemblances in terms of clinical manifestations and radiological characteristics. The absence of distinctive symptoms can create complexities in diagnosing and treating these infections, making it difficult to distinguish them from other medical conditions. Scholars propose that these infections should be considered in patients displaying symptoms such as eosinophilia, severe respiratory infection, immunosuppression, and unsuccessful response to antimicrobial therapy. Radiographic findings from X-rays and CT scans related to these infections comprise patchy or streaky shadows, cystic lesions, abscesses, ground-glass opacity, patchy consolidation, and pleural effusion. These findings present challenges in distinguishing this co-infection from other common diseases that feature similar radiographic presentations.[9–11]

Further research is necessary to understand the mechanisms behind this infection in anthracosis patients. The development of anthracosis can lead to chronic lung inflammation, which may disrupt the normal functioning of the immune system. Histopathology of lung tissue reveals carbon and free particles within the macrophage cytoplasm of the bronchial wall and mediastinal lymph nodes. Serum cytokines, notably interleukin 8 (IL-8), are recognized as biomarkers for pneumoconiosis progression. IL-8 plays a vital role in recruiting and activating neutrophils in response to silica exposure, leading to the initiation and spread of inflammatory responses in both lungs.[2–4]

Further investigation showed that an increase in these markers and inflammatory processes could provide an environment for the parasite disease in anthracosis patients. Chronic inflammation may result in the release of pro-inflammatory cytokines and other mediators that can suppress the immune response and impair the body's ability to fight off infections. Furthermore, the presence of coal dust particles in the lungs can also interfere with the immune cells' clearance of pathogens and other foreign particles. This can further weaken the immune system and make individuals more susceptible to infections. In summary, anthracosis-induced chronic inflammation and interference with immune cell function in the lungs can contribute to immunodeficiency by impairing the body's ability to mount an effective immune response against pathogens.[2–4] In a study by Aggarwal et al. (2023), most patients with anthracosis and anthracofibrosis showed diffuse pulmonary involvement, and the changes caused by fibrosis, adhesion, airway inflammation, volume reduction, and pleural effusion contribute to the development and progression of pulmonary protozoan infections in individuals with anthracosis.[5]

This may lead to more severe symptoms and complications in individuals with anthracosis, underscoring the need to monitor and manage inflammation in these patients. Additionally, understanding the relationship between inflammatory markers and parasite diseases could help improve treatment strategies and outcomes for those affected by anthracosis. Further research is crucial to comprehensively grasp the mechanisms at work and devise precise interventions for vulnerable individuals. In a study by Kiani et al. (2018), they reported that there were significant differences in the CD4/CD8 ratio in BAL fluid between 30 anthracosis cases and the control group, and significant differences were found in levels of CD4/CD8 in two groups ($p = 0.02$).[2] Lee et al. (2010), conducted a study on 110 coal mines. According to their findings, IL-8 levels were significantly higher than those in the control group. The levels were also linked to the degree of pneumoconiosis control.[3] Also, the study by Lee et al. (2015), on coal mine workers with

pneumoconiosis revealed that IL-8 levels in individuals with the condition were notably elevated compared to the controls.[4]

Focusing on prevention strategies is crucial to reduce the risk of lophomonas infections in patients with anthracosis. Here are some steps that can help decrease the risk of lophomonas infections in individuals with anthracosis: avoid exposure to contaminated water sources (including lakes, rivers, or ponds), practice good hygiene (such as washing hands with soap and water before eating and after using the bathroom), maintain a healthy immune system (healthy diet, regular exercise, and managing underlying health conditions), avoid sharing personal items, and seek advice if experiencing any signs of this infection. By following these preventive measures, individuals with anthracosis can reduce their risk of lophomonas infections and maintain their overall health and well-being.

Our study had strengths. We reported an exceptionally rare case of lophomonas infection in a patient diagnosed with anthracosis. Based on the patient's illness, clinical examination, and initial radiography findings, we initially isolated the patient, suspecting possible opportunistic infections. We alerted all close contacts and screened them for potential infections. Additionally, we averted complications from each pathogen through prompt diagnosis and suitable treatment. However, we encountered limitations. The definitive diagnosis of lophomonasis required sending the patient's sample to another center, leading to delays. Despite the delays in obtaining a definitive diagnosis for lophomonasis, our team remained vigilant in monitoring the patient's progress and managing their symptoms effectively. The collaborative effort between healthcare providers, laboratory personnel, and infectious disease specialists played a crucial role in the successful treatment outcome for this complex co-infection case. Moving forward, we aim to streamline our diagnostic processes to minimize delays and enhance our ability to provide timely and accurate care for patients with rare and challenging infectious diseases.

4 | CONCLUSION

Anthracosis is a chronic lung disease marked by bronchial mucosa black pigmentation from carbon buildup. Anthracosis causes chronic lung inflammation and immunodeficiency, which are associated with parasitic conditions like lophomonas. Healthcare providers should consider both anthracosis and pulmonary lophomonosis when evaluating patients with respiratory symptoms, as early detection and treatment may lead to better outcomes for these individuals affected. The diagnosis and effective management of these conditions can help prevent further complications and improve individual health.

AUTHOR CONTRIBUTIONS

Mohammad Hadi Tajik Jalayeri: Conceptualization; project administration; supervision; writing – review and editing. **Narges Lashkarbolouk:** Data curation; investigation; resources; writing – original draft; writing – review and editing. **Mahdi Mazandarani:** Methodology; project administration; visualization; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The datasets used during the current study are available from the corresponding author on reasonable request. All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The purpose of this case report was fully explained to the patient. He was assured that the researchers would maintain confidentiality of his information. The principles of the Declaration of Helsinki conducted this case report.

CONSENT

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor in chief of this journal.

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