

CASE REPORT

A Case of Imported Plasmodium Falciparum Infection in Shaoxing

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ABSTRACT

Background: Malaria is a vector-borne infectious disease caused by the bites of female mosquitoes infected with Plasmodium on humans. In China, imported Plasmodium is the main type, among which falciparum malaria has the most severe symptoms. Improving the diagnostic ability of microscopic examination of Plasmodium in the laboratory is of great significance for early diagnosis and treatment of patients.

Methods: Thick and thin blood smears were made from peripheral blood and stained with Riez-Giemsa staining. The malaria parasites were searched for under an oil immersion microscope to distinguish the morphology of different species. The specific antigens of Plasmodium in the whole blood samples of patients were detected by the rapid diagnostic test for Plasmodium (RDT). The scatter plot of peripheral blood white blood cells can indicate the presence of infected red blood cells and can be used for auxiliary diagnosis. Fluorescence quantitative PCR can identify the species of Plasmodium.

Results: Plasmodium ring-shaped bodies can be seen on the thick blood membrane of peripheral blood. Infected red blood cells can be seen on the thin blood membrane, which are about the same size as or slightly smaller than normal red blood cells. Ring-shaped bodies can be seen inside the red blood cells, and some of the ring-shaped bodies have binuclear nuclei. Occasionally, Plasmodium gametes can be seen, which are crescent-shaped or sausage-shaped. The RDT result of this patient suggests a single or mixed infection of falciparum malaria. The patient was diagnosed with Plasmodium falciparum infection by fluorescence quantitative PCR detection and morphological analysis by the Center for Disease Control and Prevention. The patient was treated with two tablets of dihydroartemisinin piperquine.

Conclusions: Plasmodium falciparum infection is relatively rare in Shaoxing area, and laboratory tests are prone to missed diagnosis. Continuously enhancing the ability of laboratory technicians to identify the morphology of Plasmodium can provide certain assistance for early clinical diagnosis and treatment.

(Clin. Lab. 2026;72:xx-xx. DOI: 10.7754/Clin.Lab.2025.250837)

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KEYWORDS

malaria, Plasmodium falciparum, peripheral blood smear, diagnosis

INTRODUCTION

Malaria, a vectors-borne infectious disease, is caused by female mosquitoes infected with Plasmodium biting humans. Its common clinical manifestations include intermittent chills, high fever, and profuse sweating, as well as anemia and splenomegaly. The latest epidemiological data from the World Health Organization (WHO) indicates that there were approximately 263 million malaria cases worldwide in 2023, with the highest incidence

rate in Africa [1]. Although native malaria has been basically eliminated in China, imported malaria still exists, among which falciparum malaria has the most severe symptoms [2]. Early diagnosis and timely treatment are the key. Blood smear microscopic examination in the laboratory is the "gold standard" for diagnosis [3], and it can also be combined with antigen detection and PCR and other detection methods for auxiliary diagnosis. This article describes the clinical manifestations and laboratory examination procedures of a patient with imported falciparum malaria, aiming to enhance the laboratory's ability to detect malaria parasites, so as to provide assistance for the diagnosis and treatment of such patients.

CASE PRESENTATION

The patient is a 37-year-old male from Shaoxing. He experienced fatigue and poor appetite for one week, accompanied by black stools. He was hospitalized at a local health center for treatment. Later, due to a significant decrease in hemoglobin, he came to our hospital for treatment on December 10, 2024. As the patient was in critical condition due to fatigue, dizziness, headache, nausea and tinnitus, he was admitted to the emergency room for observation and treatment. Physical examination during the visit: Body temperature: 36°C; Pulse: 96 beats per minute; Breathing: 14 breaths per minute; Blood pressure: 110/74 mmHg; Blood oxygen saturation 98%. The spirit is soft, the reflex to light is sensitive, the neck is soft, there is no resistance, the heart rhythm is regular, no pathological murmurs are heard, the breathing sounds in both lungs are coarse, no obvious dry or wet rales are observed, the abdomen is soft, there is no tenderness or rebound tenderness, the muscle strength of the limbs is grade 5, the bilateral Barter's sign is negative, and there is no edema in both lower extremities. Laboratory tests: Blood routine: White blood cell count: $2.85 \times 10^9/L$, neutrophil percentage: 55.4%, neutrophil count: $1.58 \times 10^9/L$, red blood cell count: $2.31 \times 10^{12}/L$, hemoglobin: 75.0 g/L, platelet count: $156 \times 10^9/L$, whole blood high sensitivity C-reactive protein: 11.46 mg/L, total bilirubin: 28.9 $\mu\text{mol}/L$, lactate dehydrogenase: 471.0 U/L, α -hydroxybutyrate dehydrogenase: 376.8 U/L. No obvious abnormalities were found in coagulation function, plasma D-dimer, hypersensitive troponin I, hepatitis B series three, and preoperative infectious disease examinations. Provide first-level care, fluid replacement and other symptomatic treatments. The patient's blood pressure gradually decreased. By December 12th, it had dropped to 90/55 mmHg. The patient appeared weak and anemic. Upon re-inquiry of the medical history, it was found that the patient had a history of residence in Africa and had been infected with malaria multiple times in the past. Therefore, the clinical department suspected that it was Plasmodium infection and instructed the laboratory to conduct relevant tests for plasmodium. Rapid diagnostic test strips

(RDTs) are used to detect Plasmodium antigens (such as HRP-2 and pLDH), and blood smears are used for microscopic examination to find Plasmodium. The RDTs test results suggest: Plasmodium falciparum infection or mixed infection; Thick and thin smears of peripheral blood were prepared and stained with Riez-Giemsa staining. When magnified 1,000 times with an oil immersion lens, annular bodies were found on the thick blood membrane (Figure 1 A/B). Infected red blood cells were found on the thin blood membrane, and the size of these red blood cells was comparable to or slightly smaller than that of normal red blood cells. Ring-shaped bodies could be seen inside the red blood cells (Figure 1C), and some of the ring-shaped bodies had binuclear nuclei. Occasionally, gametes of the malaria parasite were seen, shaped like crescent or sausage (Figure 1D). Checking the scatter plot of white blood cells in the blood routine test shows that the instrument indicates the presence of infected red blood cells. Based on the patient's epidemiological history and laboratory test results, it was initially determined that the patient was an imported case of falciparum malaria. The blood sample was sent to the Shaoxing Center for Disease Control and Prevention for re-examination. Eventually, it was determined that the patient was infected with falciparum malaria, and two dihydroartemisinin piperquine tablets were used for treatment.

DISCUSSION

There are mainly five types of Plasmodium that infect humans, including Plasmodium falciparum, Plasmodium vivax, Plasmodium terarium, Plasmodium ovale, and Plasmodium knowlesi [4]. Among the imported plasmodium parasites in China, vivax malaria and falciparum malaria are relatively common. Among them, falciparum malaria has the most severe clinical symptoms and is prone to cause cerebral malaria, leading to coma and even death [5]. Mihu AG et al. [6] once reported the process of infection with falciparum malaria in a 44-year-old white woman. The test results found that 10 - 15% of the red blood cells in her peripheral blood smear were infected with Plasmodium falciparum circulars, and the growth rate of Plasmodium falciparum was very fast, resulting in a rapid deterioration of the condition and eventually death due to multiple organ failure.

To prevent the recurrence of malaria in China after its elimination, the country has implemented the "1-3-7" monitoring and response strategy [7]. What our clinical laboratory needs to do well is to combine the clinical manifestations and epidemiological history of patients to improve the diagnostic ability of malaria parasites and provide assistance for early clinical diagnosis. The current laboratory diagnostic methods for malaria mainly include 1) Immunological diagnosis (detection of Plasmodium specific antigens): no equipment is required, the operation is simple (results are available in

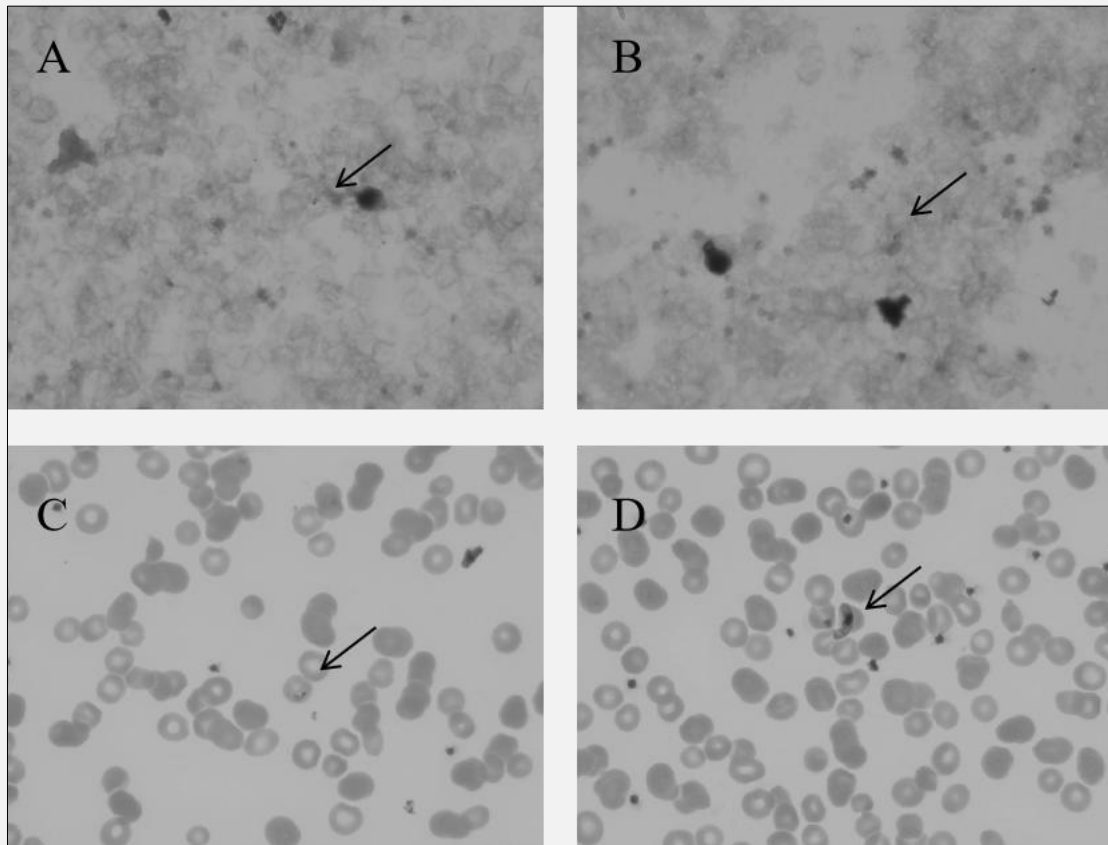


Figure 1. Morphological examination of Plasmodium falciparum (Ridge stain, x 1,000).

A/B: Plasmodium ring-shaped bodies in thick blood smears.
C: Plasmodium ring-shaped bodies in blood smear slices.
D: Gametocytes of Plasmodium in blood smear slices.

15 minutes), it is easily disturbed, and it cannot distinguish the species of the parasite, 2) Etiological diagnosis (blood smear test): It is the gold standard for detecting Plasmodium, but the operation is rather complicated. When the density of Plasmodium is low, it is easy to miss the diagnosis, and 3) Molecular biology diagnosis (amplification of Plasmodia-specific RNA fragments): It has high sensitivity and is suitable for low-density infections. It can distinguish between insect species and mixed infections, but it requires the support of professional laboratory equipment. Complete blood cell count and white blood cell scatter plot analysis can also provide auxiliary diagnosis for Plasmodium infection. Of course, there are also some emerging technologies such as direct viability assessment (DVA) that can evaluate the efficacy of Plasmodium infection [8]; Nuclear magnetic resonance relaxation (MRR) technology is used to detect malaria pigment in Plasmodium [9]; Deep learning dynamic imaging can track infected red blood cells

[10], etc., and can be used as a method for the early detection of malaria parasites. In terms of treatment, there is already a certain degree of resistance to artemisinin at present [11,12]. Some scientists have studied the related pathways after artemisinin resistance occurs, providing a direction for eliminating artemisinin resistance [13, 14]. Some literature indicates that a vaccine capable of blocking the transmission of Plasmodium falciparum has been developed [15], but its efficacy evaluation still needs further verification.

This case involves a young patient who presented with a sudden drop in hemoglobin. During the visit, there was no obvious regular change in body temperature, and the symptoms of malaria were not typical, making it easy to miss the diagnosis. At this time, it is particularly important to inquire about the patient's epidemiological history. In addition, blood smear microscopic examination has significant diagnostic value for Plasmodium. However, as the cases encountered in daily work are rela-

tively few and the malaria parasite is prone to be missed when its density is low, it is necessary to enhance the microscopic examination ability of the malaria parasite. Therefore, continuous training in plasmodium-related professional knowledge and operational skills, as well as strengthening the study of plasmodium morphology, are key to improving the detection rate of Plasmodium. Under the cooperation of multiple disciplines, it provides certain assistance for early diagnosis and treatment of patients.

Source of Support:

This research project was funded by the Medical Science and Technology Project of Zhejiang Province (no. 2025KY1685).

Declaration of Interest:

All authors declare that they have no competing interests.

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