

Pneumocystis jirovecii Pneumonia: Unveiling the Enigmatic Fungal Lung Infection

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Description

Pneumocystis jirovecii pneumonia (PJP) is a life-threatening lung infection caused by the opportunistic fungus *Pneumocystis jirovecii*. This infection primarily affects individuals with weakened immune systems, such as those with HIV/AIDS, organ transplant recipients, or individuals receiving immunosuppressive therapy. In this article, we delve into the complexities of *Pneumocystis jirovecii* pneumonia, exploring its characteristics, risk factors, clinical presentation, and treatment options.

Although PCP is the most common AIDS-defining illness in HIV-infected populations, its incidence has decreased with highly active antiretroviral therapies (HAART) and routine prophylaxis against PCP in HIV patients with CD4 counts less than 200/ μ l. However, in recent years, its importance and incidence have been increased in non-HIV immunocompromised individuals due to the severity of disease in these populations and the increased usage of immunosuppressive or immune-modulating therapies for underlying disorders such as hematological malignancies, organ transplantation especially among renal transplant recipients, and autoimmune disorders. Recently, a cluster of PCP cases was reported among liver transplant recipients also.

Traditionally, the laboratory diagnosis of PCP is based on visualization of organism in respiratory specimens using various staining techniques. But the traditional microscopy has major drawbacks of inherent low sensitivity and the need for a skilled microbiologist. In recent years, molecular diagnostics have developed with the growing importance of PCP. The polymerase chain reaction (PCR) method is preferred over the conventional microscopic methods as PCR is rapid and found to have higher sensitivity. However, its specificity declined as it detects colonization also. In a real-time PCR (qPCR), a cycle threshold (CT) value, i.e., cycle number at which fluorescence generated in a reaction crosses the threshold, can be used to differentiate or exclude colonization from active disease as the CT values are correlated with the burden of organisms; the higher the fungal burden the lower the CT and vice versa. In addition, qPCR can be used to rule out the disease as it has a high negative predictive value (NPV) of nearly 100%.

Bronchoalveolar lavage (BAL) is an ideal sample for the diagnosis of PCP, but it is challenging to perform bronchoscopy on all patients. However, non-invasive samples such as induced sputum were also found to have a sensitivity of 85 to 100% and

good concordance with qPCR results from BAL samples. Therefore, this study aimed to analyze the diagnostic value of a *Pneumocystis* qPCR method in a routine diagnostic laboratory and determine the cut-off CT value to differentiate active pneumonia from colonization.

Understanding *Pneumocystis jirovecii* Pneumonia

Fungal Pathogen and Transmission: *Pneumocystis jirovecii* is an atypical fungus that cannot be cultured using standard laboratory techniques. It is believed to be an airborne pathogen, and its exact mode of transmission remains unclear. However, it is thought that the fungus spreads through the inhalation of aerosolized fungal spores present in the environment. **Pulmonary Infection and Pathogenesis:** Upon inhalation, *Pneumocystis jirovecii* spores reach the lungs and primarily affect the alveoli, which are responsible for oxygen exchange. The fungus invades the alveolar walls, causing inflammation and thickening, leading to impaired gas exchange and respiratory distress. The exact mechanisms by which *Pneumocystis jirovecii* causes disease are not fully understood, but it is believed to involve a complex interplay between the fungus, host immune response, and tissue damage.

Risk Factors and Clinical Presentation

Immunocompromised Individuals: *Pneumocystis jirovecii* pneumonia primarily affects individuals with weakened immune systems. The most common risk factor is HIV/AIDS, particularly in individuals with low CD4+ T-cell counts. Other risk factors include organ transplantation, prolonged use of immunosuppressive medications (e.g., corticosteroids), hematological malignancies, and certain autoimmune diseases. **Clinical Presentation:** The clinical presentation of *Pneumocystis jirovecii* pneumonia can vary depending on the severity of the infection and the underlying immune status of the individual. Common symptoms include progressive shortness of breath, non-productive cough, fever, and chest tightness. The infection can rapidly progress, leading to respiratory failure if left untreated.

Diagnosis of *Pneumocystis jirovecii* Pneumonia: The diagnosis of PJP involves a combination of clinical evaluation, radiological imaging, and laboratory tests. Chest X-rays or computed

tomography (CT) scans may reveal characteristic patterns, such as bilateral interstitial infiltrates. Laboratory tests include sputum or bronchoalveolar lavage (BAL) fluid analysis, where the presence of *Pneumocystis jirovecii* can be detected using staining techniques or molecular methods like polymerase chain reaction (PCR).

Treatment Options: Prompt treatment is crucial in managing *Pneumocystis jirovecii* pneumonia. The primary treatment involves the use of antimicrobial agents, specifically trimethoprim-sulfamethoxazole (TMP-SMX), which is the first-line therapy. Alternative treatments include pentamidine, atovaquone, or a combination of clindamycin and primaquine. Adjunctive therapies, such as corticosteroids, may be used in severe cases to reduce inflammation and improve oxygenation.

Prevention and Prophylaxis: Prophylactic Measures: Prophylaxis is crucial in preventing *Pneumocystis jirovecii*

A total of 339 respiratory samples from 289 patients were tested for PCP by qPCR between January to December 2019. The PCR was positive in 20% (n = 68 samples from 59 patients) and

negative in 80% (n = 271 from 230 patients) of the samples studied. According to the clinical diagnosis, among 289 patients, 59 were categorized into PCP and 230 into non-PCP groups. The prevalence of disease during the study period was 20% (59/289). Among 59 PCP patients, PCR was negative in nine patients

PCP is an acute, life-threatening infection in both HIV-infected and non-HIV immunocompromised patients, warranting a rapid and reliable laboratory diagnostic method. The laboratory diagnosis of PCP has evolved rapidly in recent years. The highly sensitive real-time PCR assay had replaced the conventional microscopic methods in many laboratories.

The real-time PCR showed good sensitivity and specificity for routine diagnosis of PCP in patients with various underlying conditions. Colonization can be excluded with the CT value below 34 in both HIV-infected and non-HIV immunocompromised patients. Clinical correlation is needed if the CT value is above 35 to differentiate active infection from colonization