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Trends in Microbiology
Microbe of the month

Pneumocystis jirovecii

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Summary

Pneumocystis jirovecii is an ascomycete, specific for humans, characterized by a strong tropism for the lungs and an airborne host-to-host transmission. This pathogen constitutes a unique phenomenon in medical mycology. *Pneumocystis* pneumonia (PCP) was a major cause of morbidity and mortality among HIV-infected populations in the eighties and nineties. At present, it remains the main cause of AIDS defining illness in developed countries. However, an increased frequency of PCP in non-AIDS patients with defect of cellular or global immunity is reported. The fungus is also involved as a comorbidity factor in acute or chronic pulmonary diseases. For these reasons, *Pneumocystis* infections are still a serious public health issue as attested by the 250 publications published annually on [ncbi.nlm.nih.gov](https://pubmed.ncbi.nlm.nih.gov/). Here we summarize the present knowledge of *P. jirovecii* fundamental biology and epidemiology.

KEY FACTS:

P. jirovecii is the species of the *Pneumocystis* genus infecting specifically humans.

It has a worldwide distribution.

It is not routinely cultivable.

It does not have a proven environmental niche.

It is acquired and transmitted from host-to-host via the airborne route.

It shows a strong tropism for the lungs.

This pathogen constitutes a unique phenomenon in medical mycology.

Ascospores contained in asci and/or asci themselves represent the transmitted infectious stages.

P. jirovecii's cytoplasmic membrane does not comprise ergosterol that is replaced by cholesterol. For this reason, this fungus is resistant to amphotericin B and azoles.

The first genome sequence of *P. jirovecii* was published in 2012 (8,1 Mbp, 3898 coding genes)

DISEASE FACTS:

P. jirovecii is an opportunistic fungus which causes a life-threatening pneumonia in immunocompromised patients (*Pneumocystis pneumonia*, PCP). PCP is the most frequent AIDS-defining disease in developed countries. Its incidence in this context is about 400,000 cases with ca. 50,000 deaths.

Torpid infections may occur in patients with acute or chronic bronchopulmonary diseases, primary infected infants, pregnant women, and health care workers in contact with infected patients. These colonized patients and PCP patients represent sources of the infection in the community and hospitals.

The first line for treatment is sulfamethoxazole-trimethoprim (SMX-TMP).

The combination of SMX-TMP with echinocandins deserves to be evaluated.

Chemoprophylaxis remains essential but isolation measures of infected patients within the hospitals are required.

Literature

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TAXONOMY AND CLASSIFICATION:

KINGDOM: Fungi

PHYLUM: Ascomycota

SUB-PHYLUM: Taphrinomycotina

CLASS: Pneumocystomycetes

ORDER: Pneumocystidales

FAMILY: Pneumocystidaceae

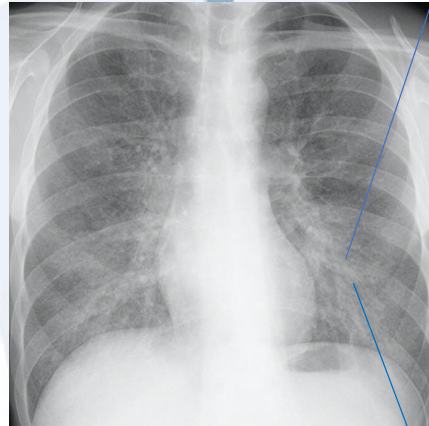
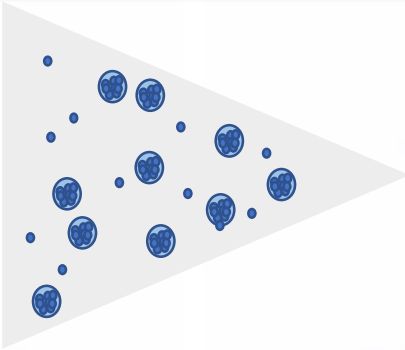
GENUS: *Pneumocystis*

SPECIES: *jirovecii*

Microphotograph caption

- A. Ascus containing ascospores (indicated by the arrow, Wright Giemsa stain, X 1000)
- B. Asci (Toluidine blue stain, X 400)
- C. Cluster of *P. jirovecii* organisms (indicated by the arrow, Wright Giemsa stain, X 100)
- D. Asci (Indirect two-step IFA, anti-ascus antibodies, MONOFLUO Kit *P. jirovecii* Bio-Rad, X 400)

Inhalation of ascospores and/or asci



Sources:

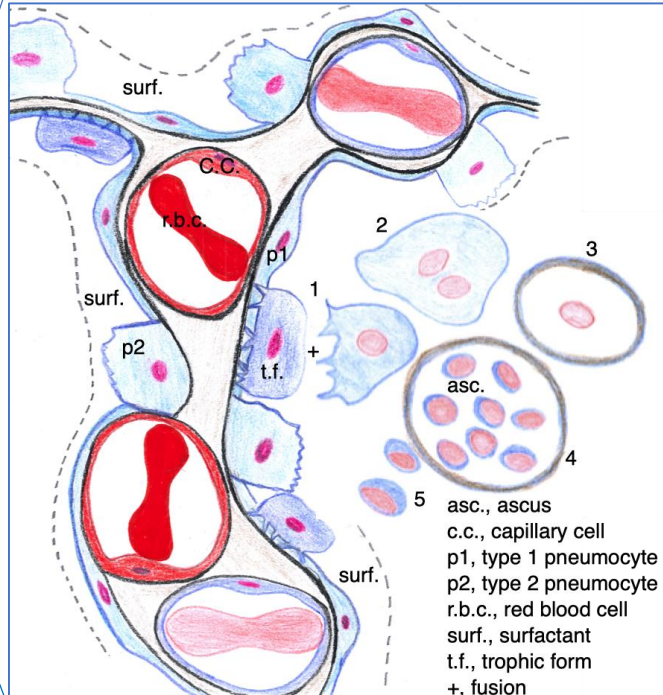
- Patients with *Pneumocystis* pneumonia (PCP)
- Infants with *Pneumocystis* primary infection
- Colonized patients
 - Patients with chronic pulmonary diseases
 - Pregnant women
 - Healthcare workers in contact with PCP patients
 - Elderly people

Evasion from immune system:

- Variation of major surface glycoproteins (MSGs)
- Masking of beta-1,3-D glucan
- Lack of chitin
- Lack of outer chain of N-mannans on MSGs

Multiplication:

- Asexual cycle, possibly facultative
- Obligate sexual cycle
 - Putative fusion of trophic forms (1, 2)
 - Diploid zygote (3)
 - Meiosis and mitosis leading to an ascus with eight ascospores (4)
 - Released ascospores (5)



Pneumocystis jirovecii in pulmonary alveoli