Pneumocystis jirovecii

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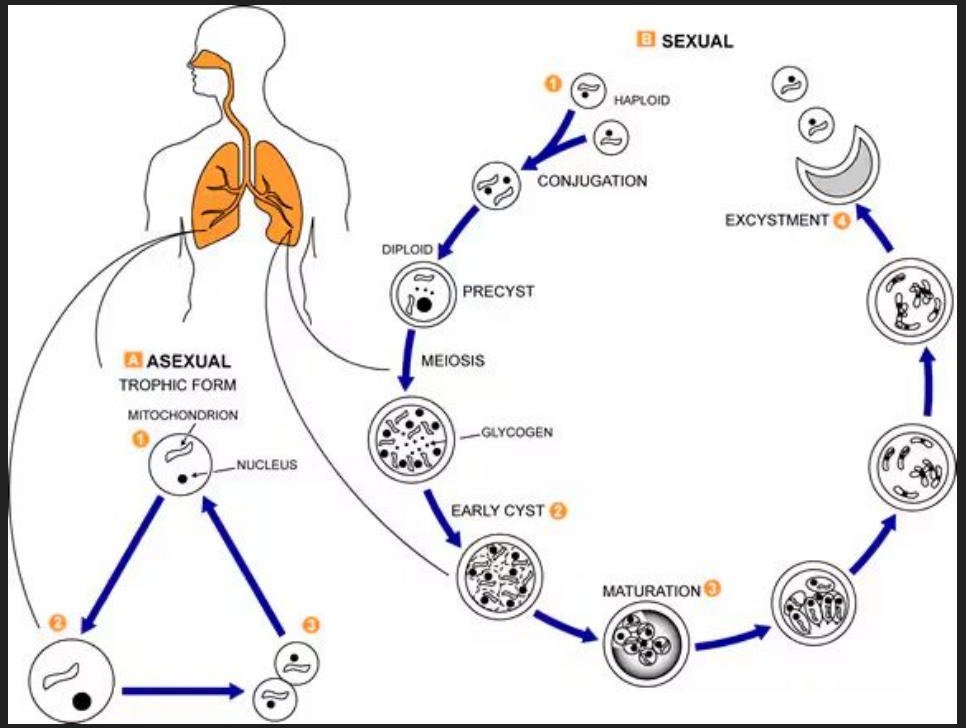
General

- *Pneumocystis* has many species that infect different mammals
- *P. jirovecii* is a fungal pathogen that causes a severe type of pneumonia, pneumocystis pneumonia (PCP) in humans
- PCP usually affects the immunocompromised, especially those with cancer, HIV, an autoimmune disease, etc
- Can be life threatening
- It is the most common and serious opportunistic respiratory infection in patients with AIDS
- These fungi are found in the lungs and can reside there without causing infection until the host's immune system becomes debilitated

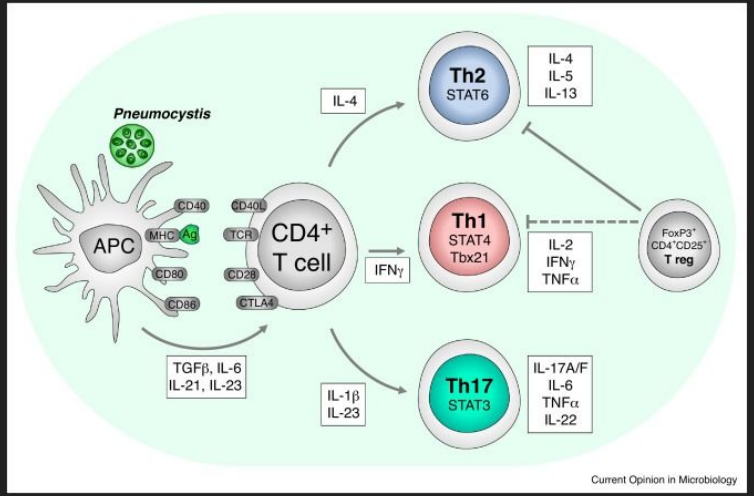
Life Cycle

- Exposure:
  - Person to person through an airborne route
  - Can be spread to others by immunocompetent as well as immunocompromised individuals
- Asexual phase:
  - Trophic forms replicate by binary fission
- Sexual phase:
  - Haploid trophic forms produce precyst, which matures into cyst through sexual reproduction
  - Within the cyst, 8 ascospores are formed which are released in excystation
  - The spores can infect new host cells or be transmitted to other individuals, continuing the life cycle



Host Response to Infection

- Innate immune response is the first line of defense
  - Macrophages recognize and engulf *Pneumocystis* through PRRs
  - Macrophages release pro-inflammatory cytokines like TNF-alpha and IL-1 beta
  - Neutrophils recruited to the site of infection
- Adaptive immune response
  - CD4+ T cells play a very central role in the immune response, IFN gamma
  - Th1 response important, Th2 and Th17 are secondary
  - B cells & antibodies
  - Natural killer cells and dendritic cells can also assist in immune response
- Host's inflammatory response is what causes significant lung injury and impaired gas exchange, leading to hypoxia and possibly respiratory failure



Pathogen Response to Host

- Pneumocystis has many immune evasion mechanisms
  - Antigenic variation
  - Some beta-glucans can be concealed under a layer of other molecules to avoid detection by immune cells
  - Can directly impair macrophage activity
  - Can induce apoptosis
- Also has adaptations to survive better in the lungs
  - Attaches to alveolar epithelial cells using adhesion proteins
  - Can induce cytokine storms that disrupt normal alveolar function
- Can be latent
  - After initial exposure, can persist asymptomatically in lungs, hiding from immune response

Outcome of Infection

- Is asymptomatic in immunocompetent individuals
- Main symptoms of PCP include dyspnea (difficulty breathing), cough, fever, and fatigue
- In severe cases, there is acute respiratory failure requiring ventilation
- Untreated PCP has a very high mortality rate
- First line treatment is high dose TMP-SMX, prognosis improves greatly with early and appropriate treatment

Summary

- *P. jirovecii* is a fungal pathogen that causes a severe type of pneumonia, pneumocystis pneumonia (PCP) in immunocompromised individuals
- Host response depends on both innate and adaptive immunity
- Pneumocystis can respond with many strategies to evade the immune system and intensify infection
- In immunocompetent individuals who have been exposed, it can be latent and persist asymptomatically in the lungs
- In severe cases can cause acute respiratory failure and can be deadly

References

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