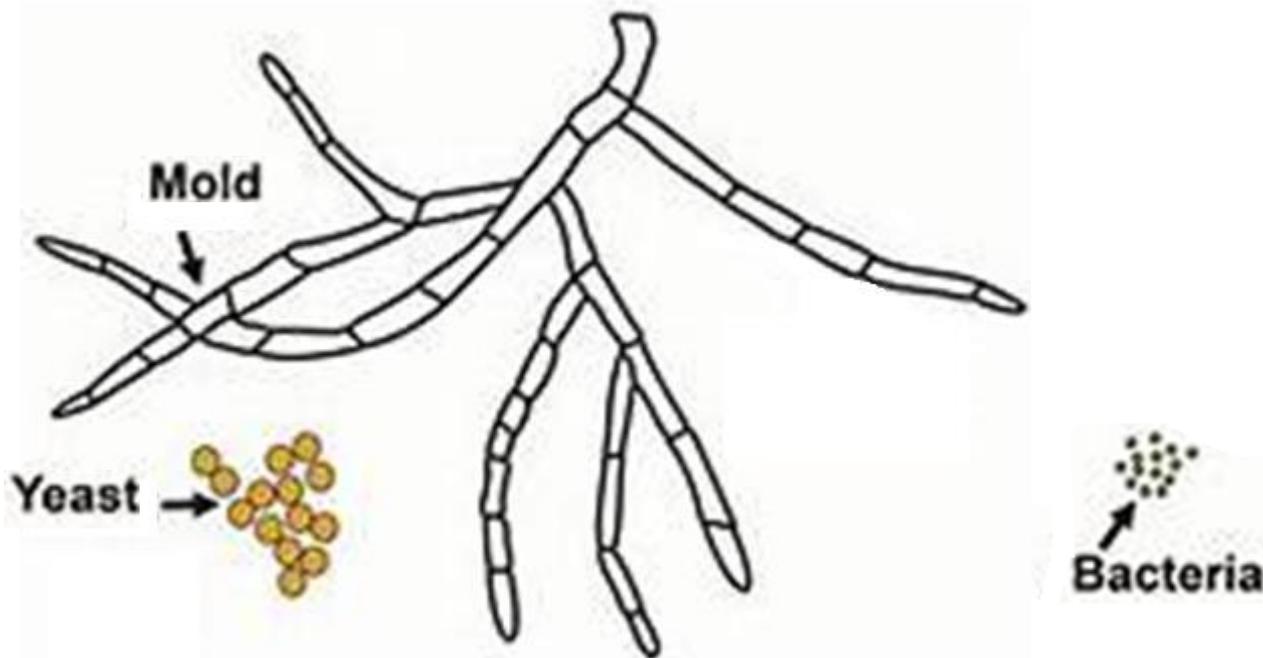


Fungal infections of Lungs (RSM 2022-2023)

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Fungi, Yeasts, Molds

- A **mold** is a fungus that grows in the form of multicellular filaments called *hyphae*.
- Yeasts are fungi that can adopt a single-celled growth habit.



Structure of Fungi

Fungi

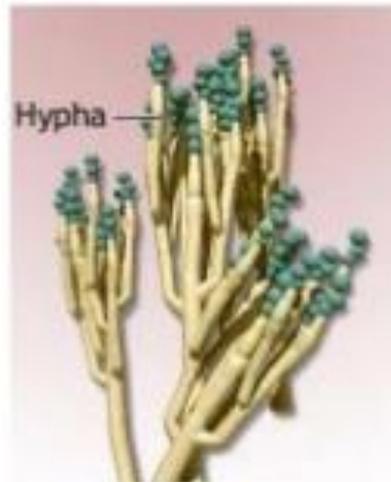
Yeast

Yeasts are single-celled forms that reproduce by



Filamentous

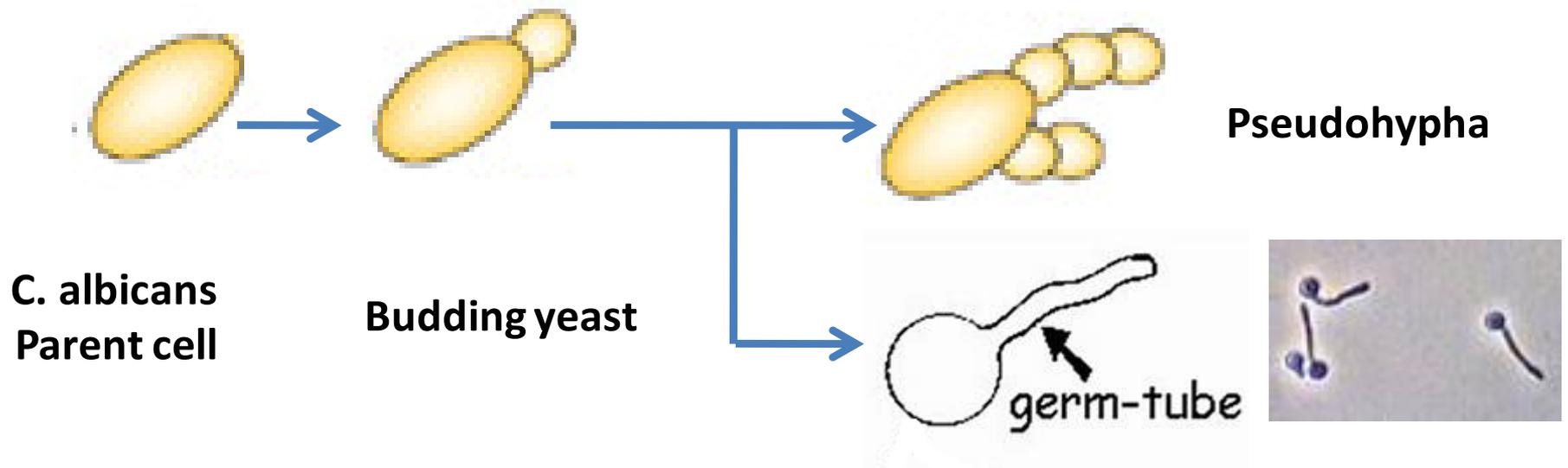
Also called as molds, form multicellular hyphae



Dimorphic

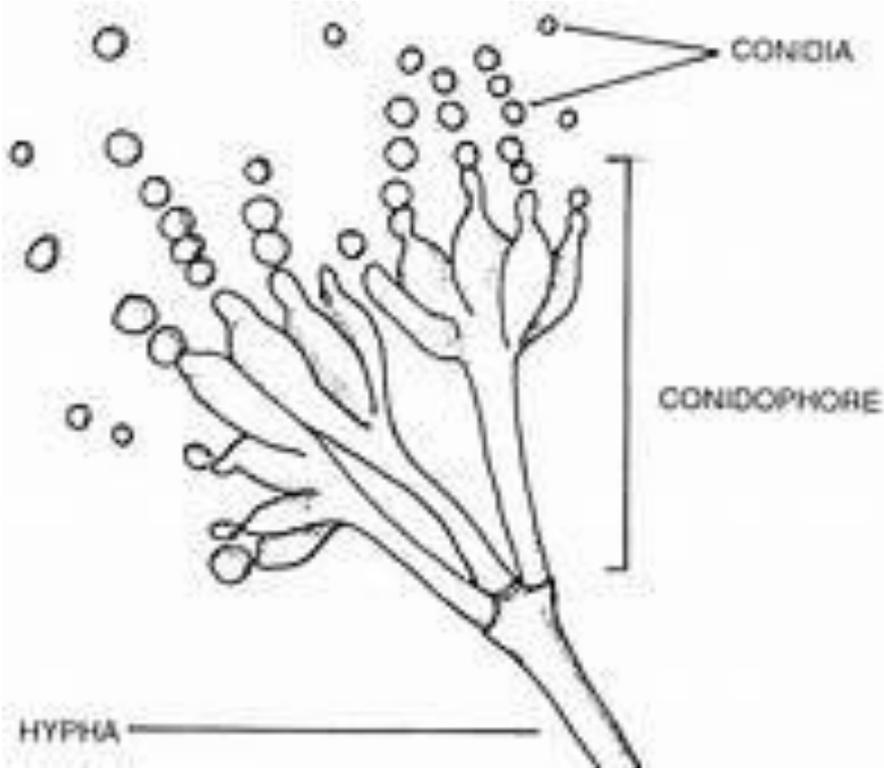
Dimorphic fungi grow as yeasts or spherules in vivo and in vitro at 37°C, but as molds at 25°C.

Structure of Fungi



When *Candida* is grown in human or sheep serum at 37°C for 3 hours, they form germ tubes (filamentous outgrowth), which can be detected with a wet film as filamentous outgrowth extending from yeast cells

Structure of Fungi



- Hyphae (Hypha, singular): is a long, branching filamentous structure of a fungus with fruiting body on the top that give conidia .
- Hyphae may be septate, having internal septa, or nonseptate.

Pulmonary Mycosis

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graph TD; A[Pulmonary Mycosis] --> B[Due to primary pathogenic fungi]; A --> C[Due to opportunistic fungi]; B --> D["1- Histoplasma capsulatum  
2- Coccidioides immitis"]; D --> E[Systemic Pulmonary Mycosis]; C --> F["1- Aspergillus fumigatus  
2- Pneumocystic jirovicii"];
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Due to primary pathogenic fungi

1- *Histoplasma capsulatum*

2- *Coccidioides immitis*

Systemic Pulmonary Mycosis

Due to opportunistic fungi

1- *Aspergillus fumigatus*

2- *Pneumocystic jirovicii*

Characters of systemic pulmonary mycoses:

1. Infection acquired by **Inhalation of fungal spores** (conidia).
2. Most fungal lung infections are **asymptomatic** and self – limiting. However, in some persons mainly **immunocompromised** , infection disseminates to other organs.
3. Infected persons **rarely transmit** the disease to others.

Predisposing factors and causes of fungal infection:

- 1- Taking strong antibiotics for a long period of time.**
- 2- Suppression of the immune system by diseases (ex. AIDS, diabetes), or drugs as steroids and chemotherapy.**
- 3- Very young and very old people are groups at risk.**

Pulmonary mycosis due to Primary pathogenic fungi

1- Histoplasmosis

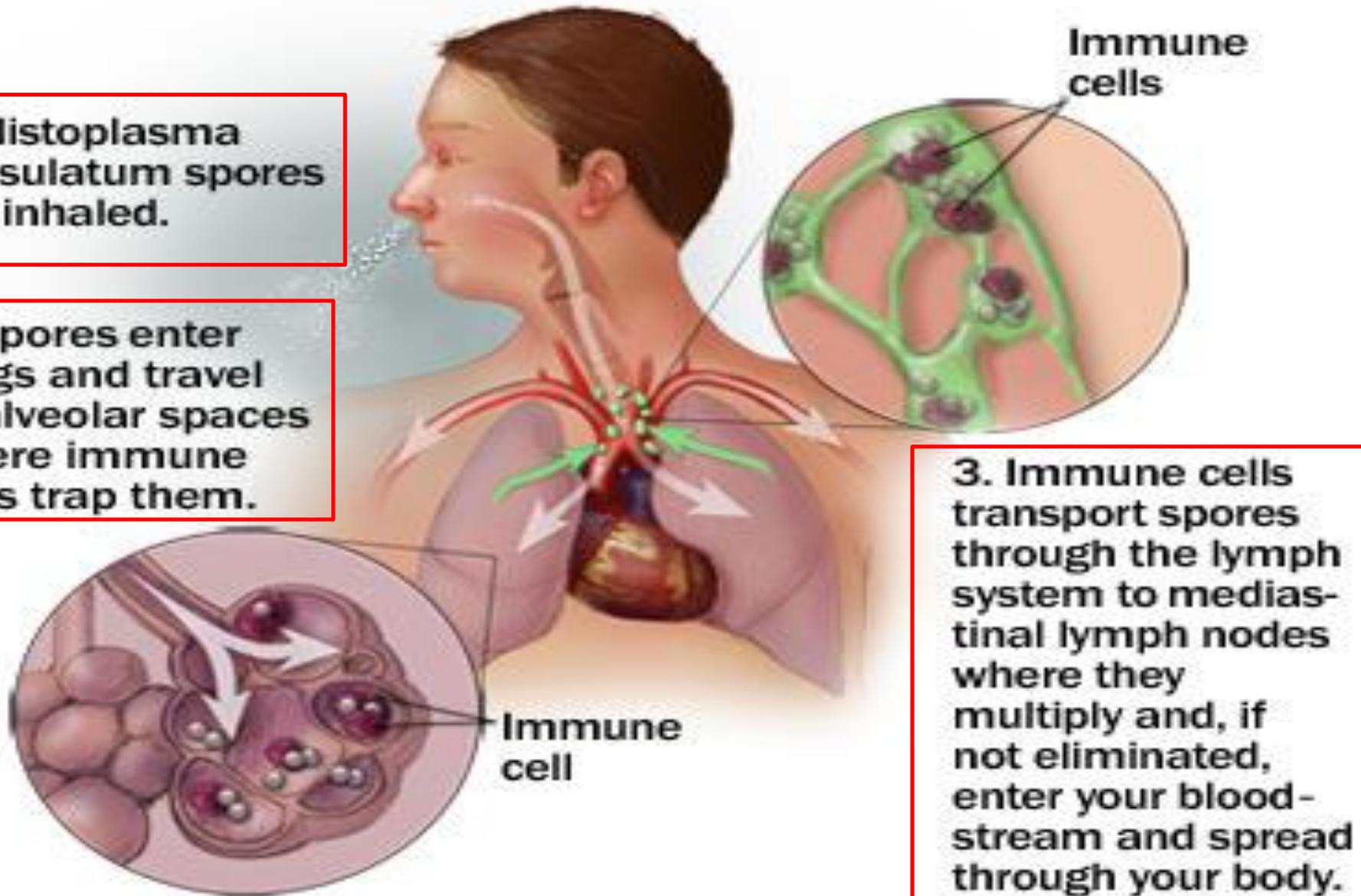
- A disease usually affecting the lungs caused by *Histoplasma capsulatum* fungus.
- Causing acute pneumonia or chronic cavitory lesions in the lungs as T.B.
- This fungus is dimorphic lives and grows best in soil mixed with bird or bat excreta as filamentous form & yeast form in tissues .
- Endemic in the United States.
- Unlike its name; Histoplasma capsulatum is not encapsulated. The designation H. capsulatum is actually a misnomer. Virulence factor: Ability to survive within the macrophage probably by modulating the pH within the phagolysosome is the key virulence factor of Histoplasma capsulatum.

Mode of infection & life cycle

1. Histoplasma capsulatum spores are inhaled.

2. Spores enter lungs and travel to alveolar spaces where immune cells trap them.

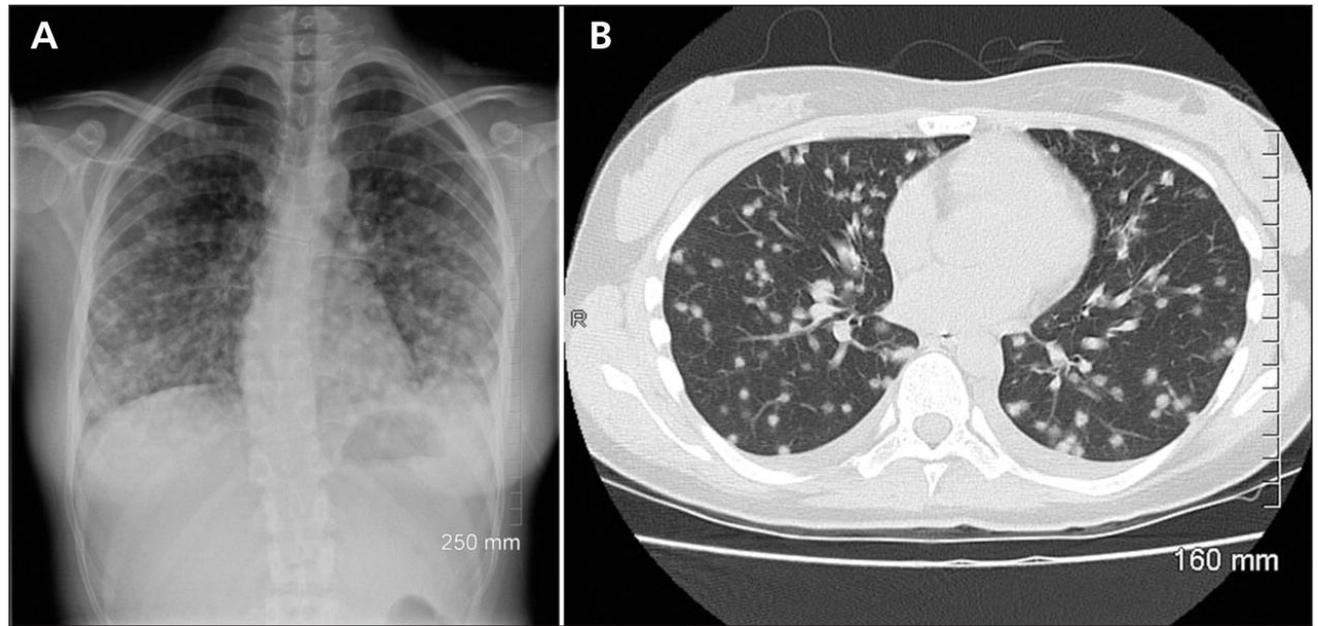
3. Immune cells transport spores through the lymph system to mediastinal lymph nodes where they multiply and, if not eliminated, enter your bloodstream and spread through your body.



Clinical pictures

1. Most of infected people are **asymptomatic (95%)**.
2. 5% may have **acute pneumonia with flue-like symptoms** (ex. fever, chills, headache, cough, chest pain, fatigue, body aches, mouth sores) & red skin bumps called **erythema nodosum**, most often on the **lower limbs**.
3. Sometimes the infection progress to become **chronic**.
4. In immunocompromised patients, **the infection disseminates to different organs** via reticuloendothelial cells to the liver, spleen & L. nodes their enlargement and to CNS headache & neck stiffness due to high fever.

**Acute pulmonary
histoplasmosis**



Erythema nodosum



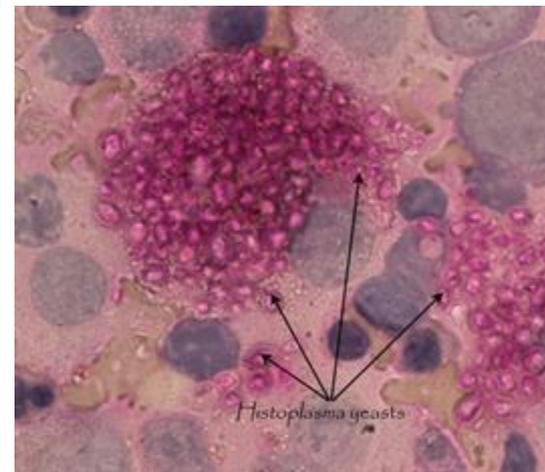
Laboratory diagnosis

Direct

- **Microscopic Examination:** of sputum, biopsy specimens, bone marrow aspirates, urine or blood films after staining with Periodic Acid Schiff (**PAS**) or Calcofluor white or Giemsa stains
- **Chest X ray & CT scan.**
- **Culture** of specimens on **Sabouraud's agar** at 25 (up to 3 weeks)

Indirect

- **Skin test:** using fungal antigen (histoplasmin).
- **Serological tests:** to detect Abs, or fungal antigen.
- **PCR.**



Periodic Acid Schiff staining

Treatment

Oral

By itraconazol

- In acute cases, the drug is used for 6-12 ws.

- In severe infection, chronic & disseminated histoplasmosis, the drug is used for 3 months to one year .

Parenteral

By amphotrecin B
(IV)

-It used in disseminated infection.

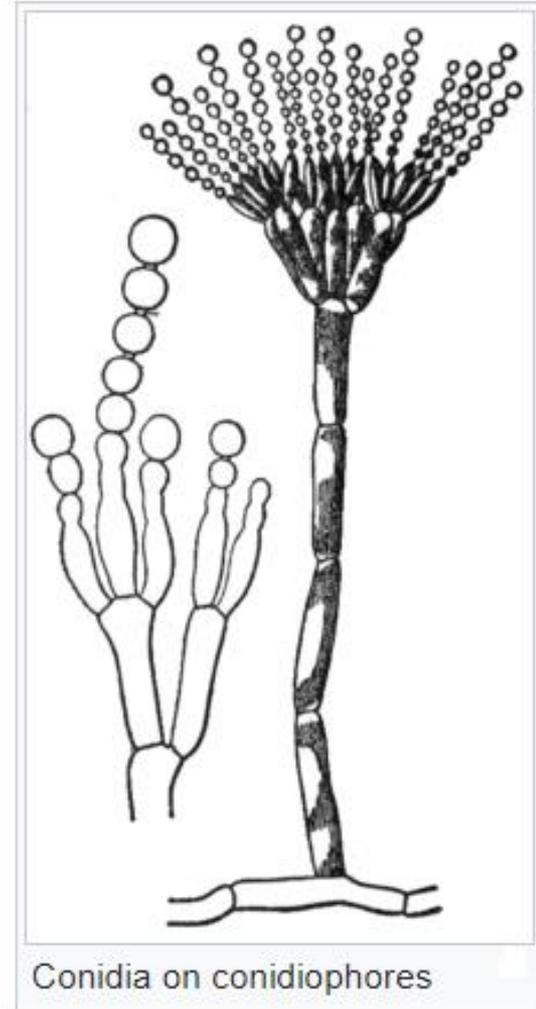
- Bind to ergosterol or inhibits its synthesis in the cell membrane.

- Nephrotoxic.

Pulmonary mycosis due to opportunistic fungi

1- Aspergillosis

- A fungus infection caused by *Aspergillus spp.*
- Wide spread as **saprophytic moulds**.
- **Filamentous fungus** with septate hyphae and ***Aspergillus* head (conidia or spores)**.
- **Airborne** found in soil, water, contaminate starchy food, on decaying organic vegetation, on pillow or bedding, and air conditions.



Causes: 3 important medical species

- 1- *A. fumigatus* → causing pulmonary aspergillosis.
- 2- *A. flavus* → causes sinus and cutaneous infections..
- 3- *A. niger* → causing invasive infections and otitis.

Pulmonary aspergillosis

- It is a disease affecting the lung caused by *A. fumigatus* fungus.
- **Portal of entry:** nasal passage & respiratory tract (inhalation of spores).
- The disease may occur in 3 forms:
 - 1- Allergic pulmonary aspergillosis.
 - 2- Aspergilloma or fungal ball.
 - 3- Invasive aspergillosis.



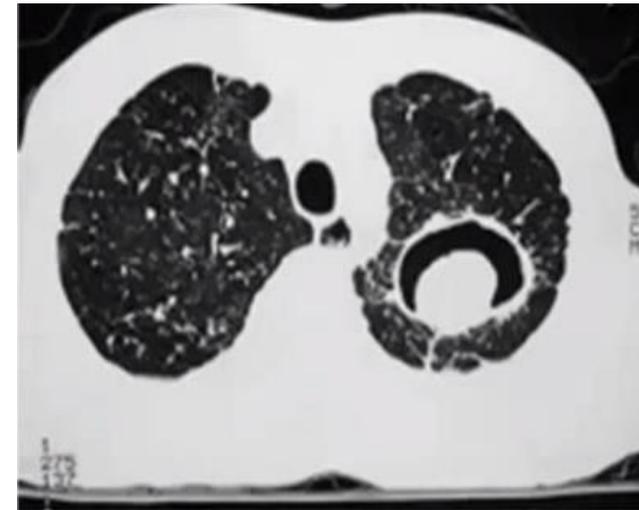
1- Allergic pulmonary aspergillosis

- Occurs due to hypersensitivity reaction to *A. fumigatus* infection of the major air ways.
- C/P: recurrent attack of wheeze, cough & expectoration.

2- Aspergilloma or fungal ball

➤ Fungal colonization of *A. fumigatus* in a pre-existing lung cavity (TB) or dilated bronchus without tissue invasion.

➤ C/P: usually asymptomatic may be haemoptysis occurs.



Chest CT demonstrating an aspergilloma within a prior lung cavity – note minimal surrounding tissue inflammation

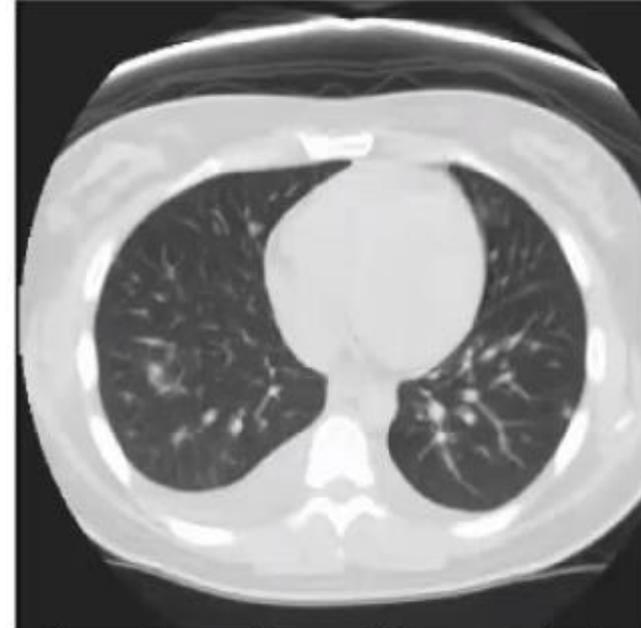
3- Invasive aspergillosis

- ✓ Affect mainly immunocompromised patients.
- ✓ Causing acute pneumonia & haemoptysis with or without dissemination.

Laboratory diagnosis

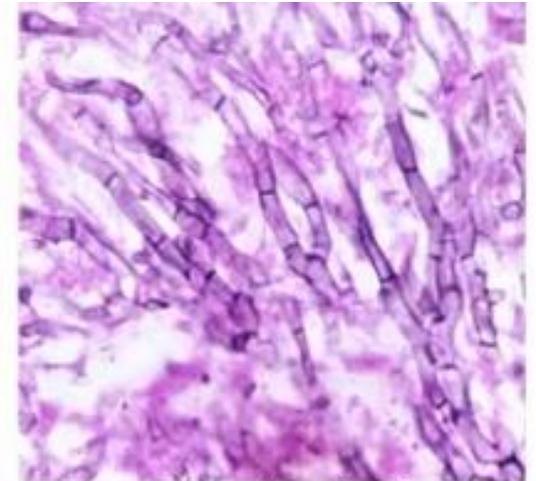
Culture:

- On Sabouraud's agar.
- *Aspergillus* spp. can be identified by the pigmentation of their growth in the culture as follows:
 - *A. fumigatus*: gives white filaments with green spores.
 - *A. flavus*: gives white filaments with yellowish green spores.
 - *A. niger*: gives white filaments with black spores.



Chest CT revealing small lung nodules in early, invasive pulmonary aspergillosis

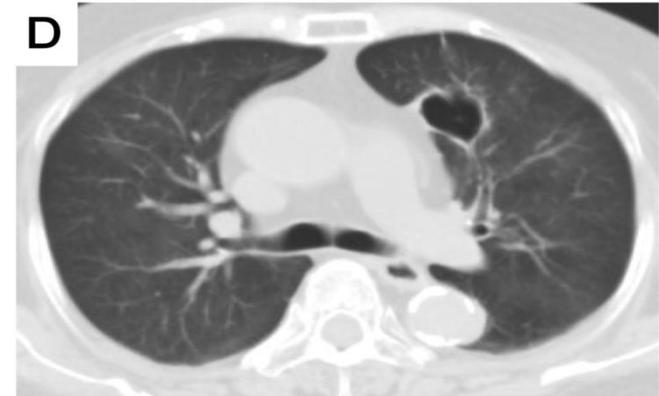
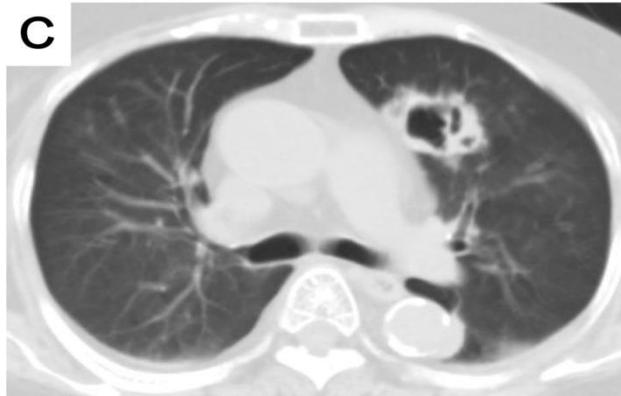
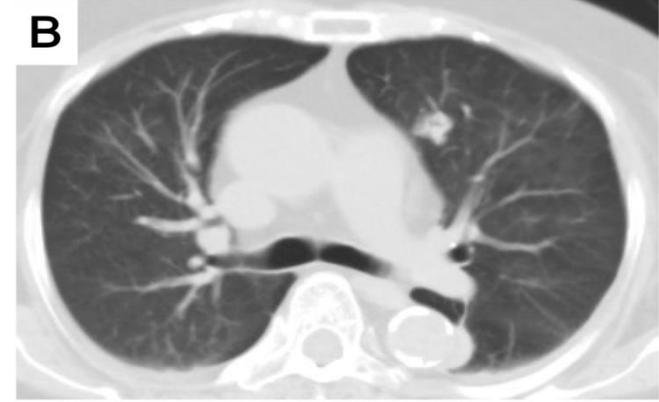
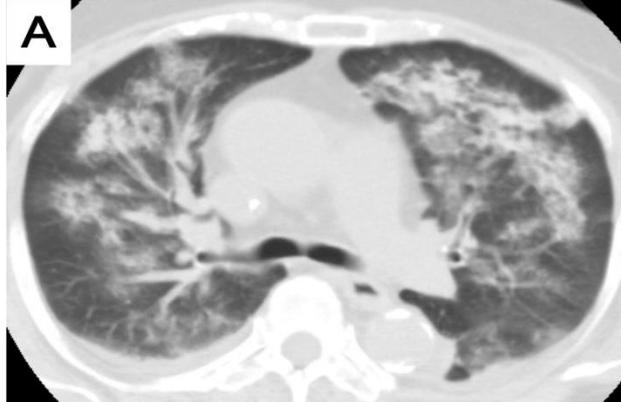
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Fungal hyphae in tissue

12

Invasive aspergillosis



Treatment

1- Antifungal drugs in invasive pulmonary aspergillosis and disseminated disease:

➤ Amphotericin B (IV) & oral itraconazole.

2- Surgical removal of fungal ball in lung.