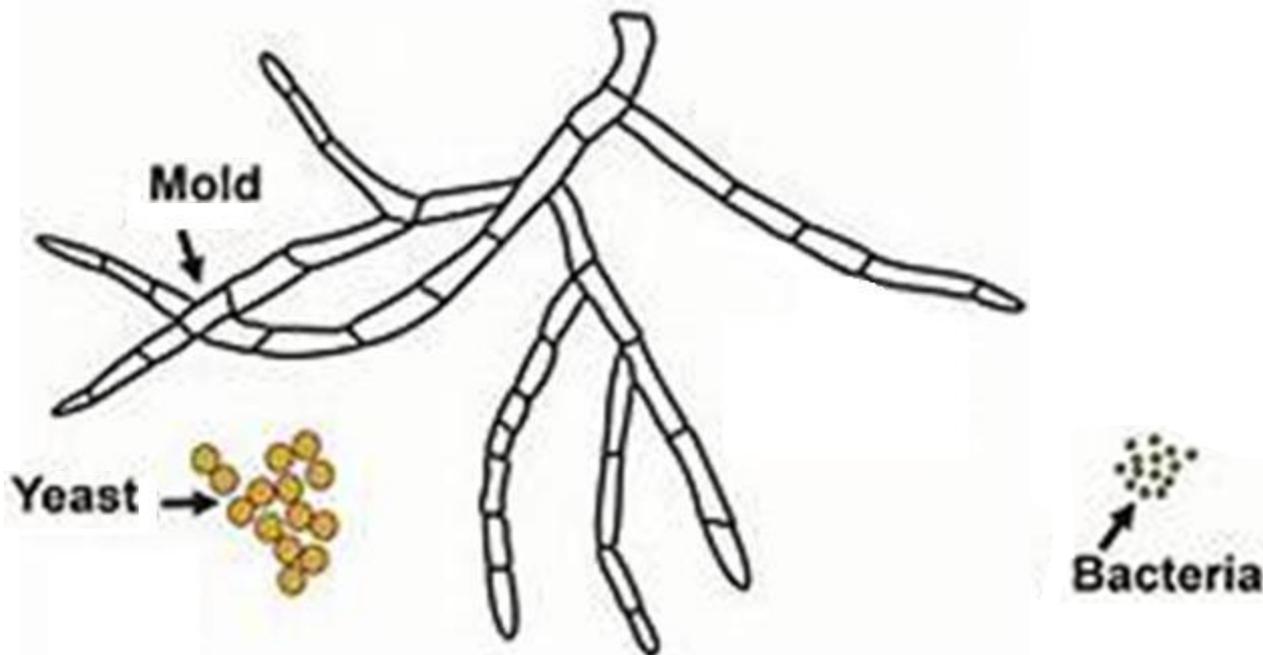


# **Fungal infections of Lungs (RSM 2023-2024)**

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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

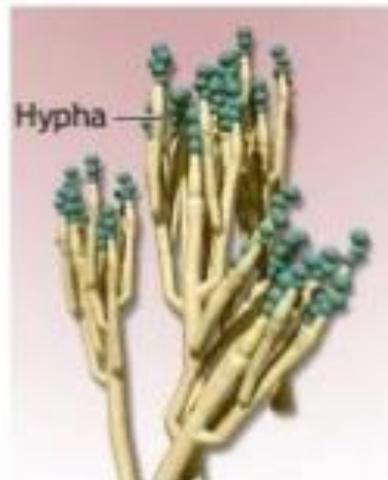
Yeast

Yeasts are single-celled forms that reproduce by



Filamentous

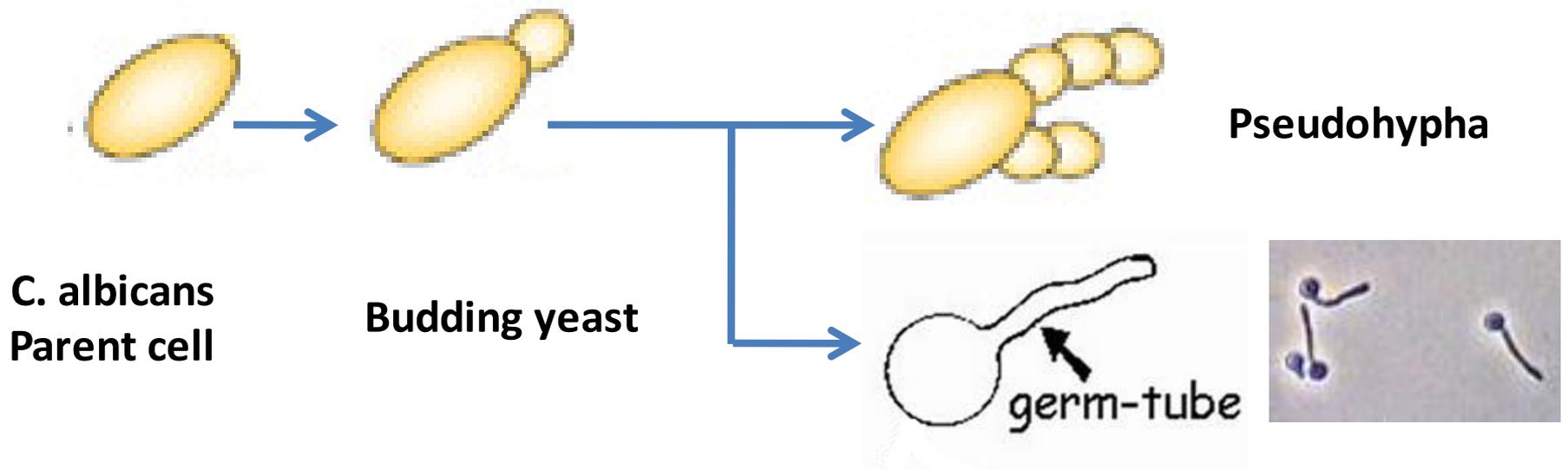
Also called as molds, form multicellular hyphae



Dimorphic

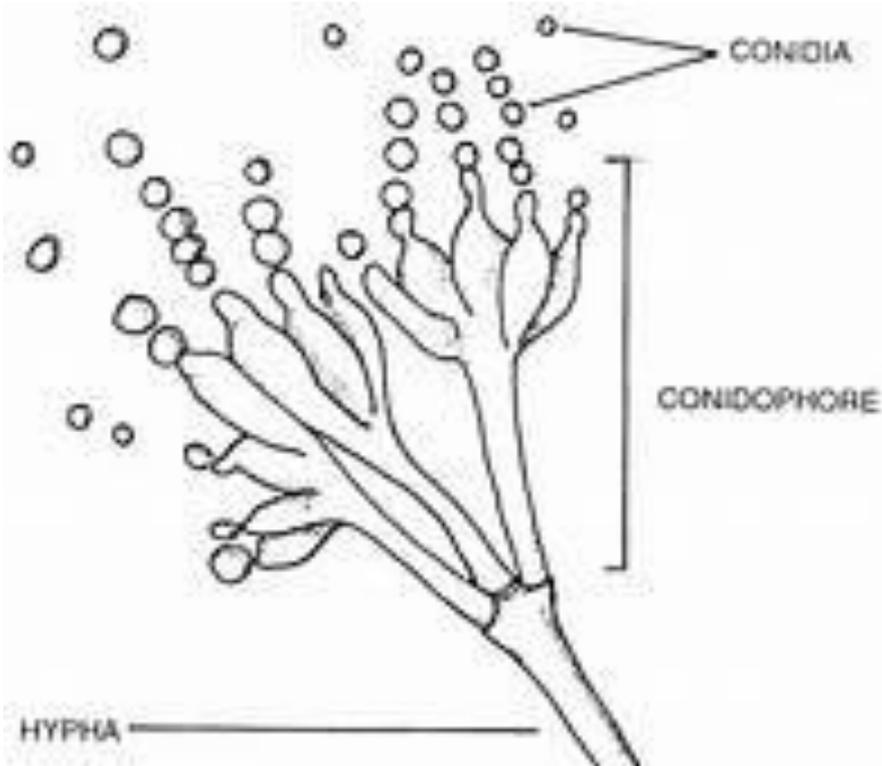
Dimorphic fungi grow as yeasts or spherules in vivo and in vitro at 37°C, but as molds at 25°C.

# 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

```
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"];
```

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

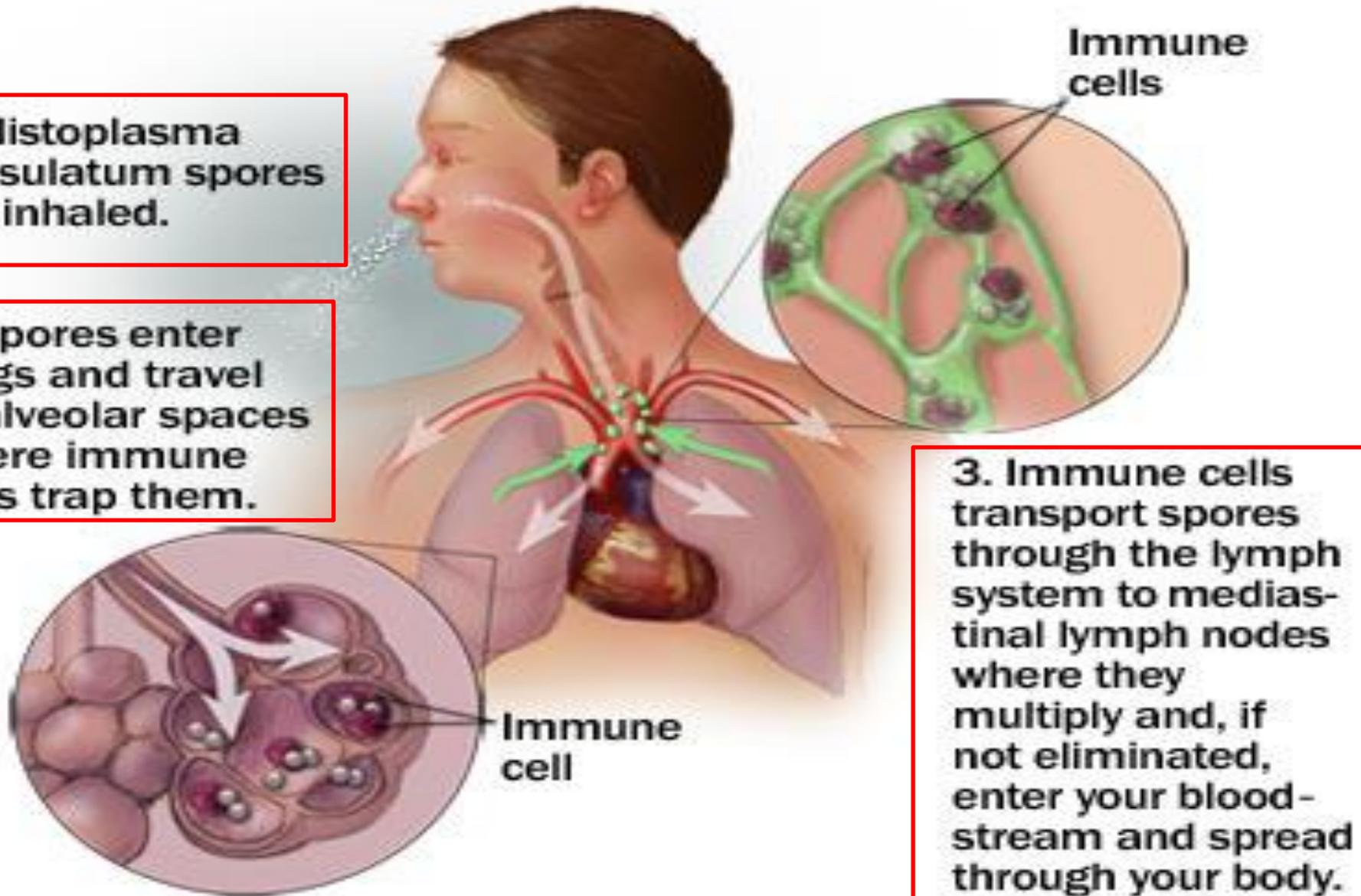
- A disease usually affecting the lungs caused by *Histoplasma capsulatum* fungus.
- Causing acute pneumonia or chronic cavitory lesions in the lungs as T.B.
- This fungus is dimorphic lives and grows best in soil mixed with bird or bat excreta as filamentous form & yeast form in tissues .
- Endemic 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.**

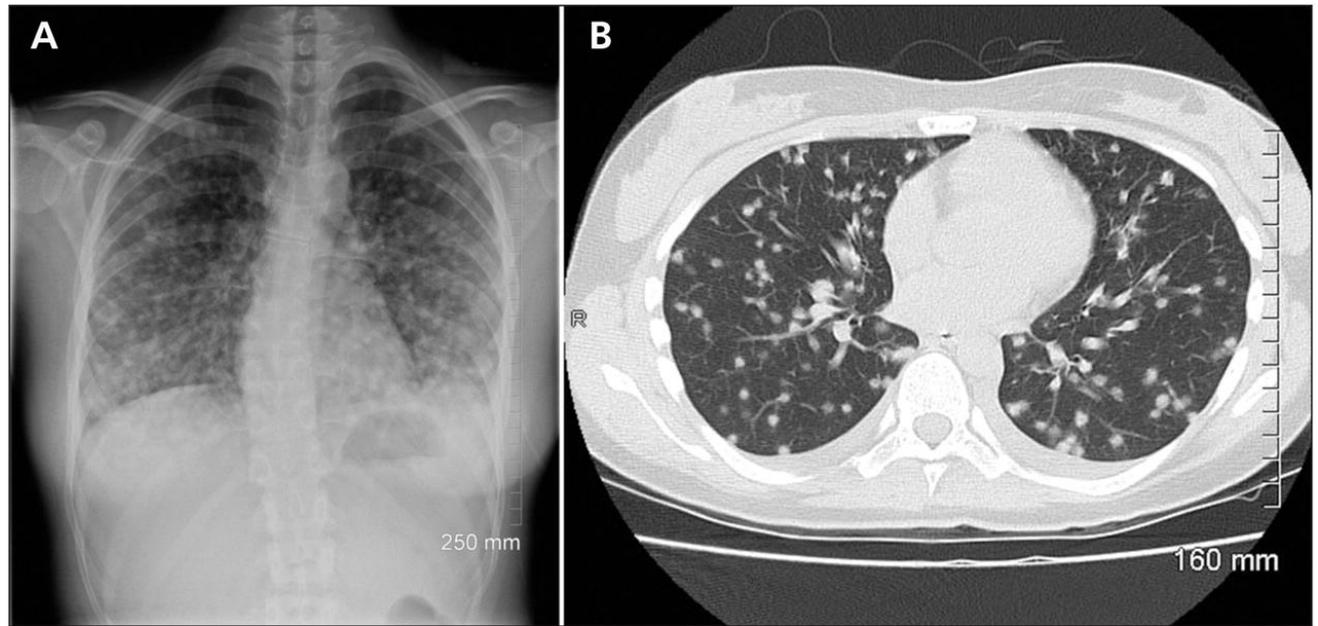
**3. Immune cells transport spores through the lymph system to mediastinal lymph nodes where they multiply and, if not eliminated, enter your bloodstream and spread through your body.**



## 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**



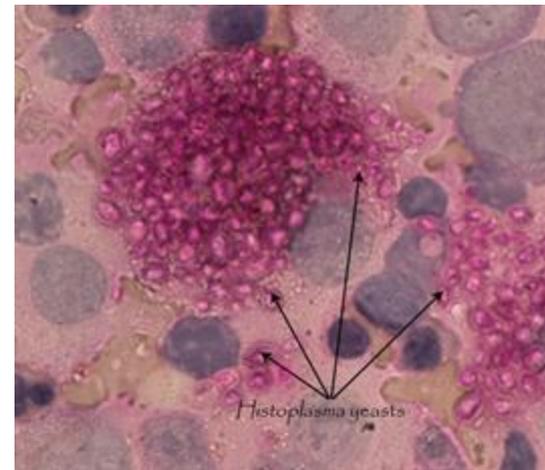
# Laboratory diagnosis

## 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.

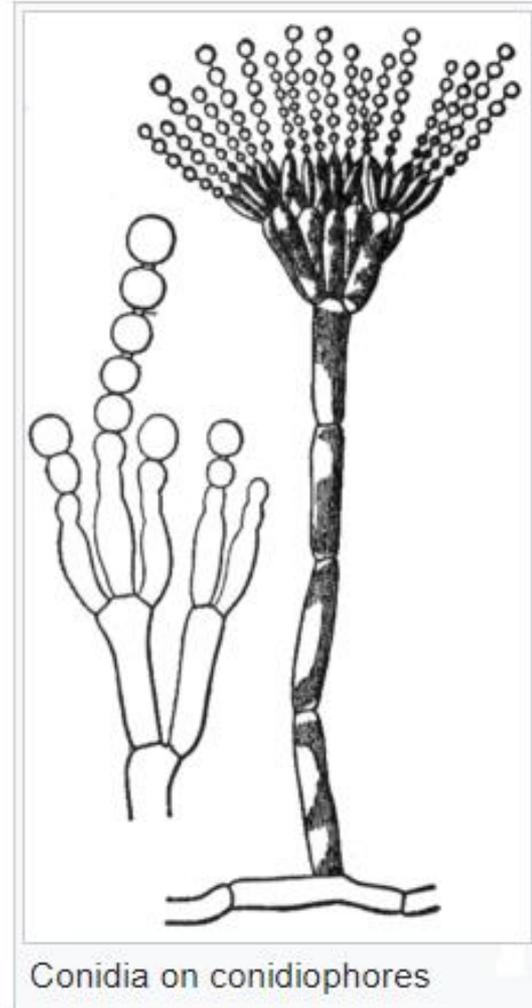
- Bind to ergosterol or inhibits its synthesis in the cell membrane.

- 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.



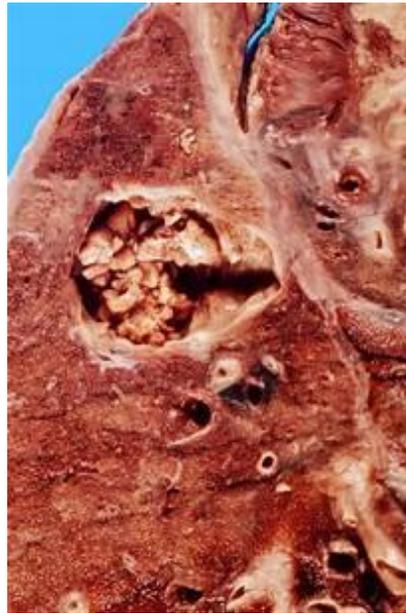
## 1- Allergic pulmonary aspergillosis

- 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

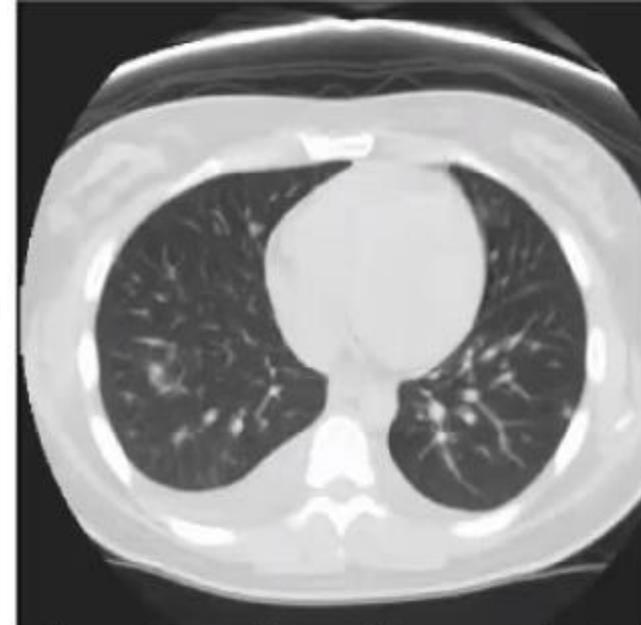
### 3- Invasive aspergillosis

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

### Laboratory diagnosis

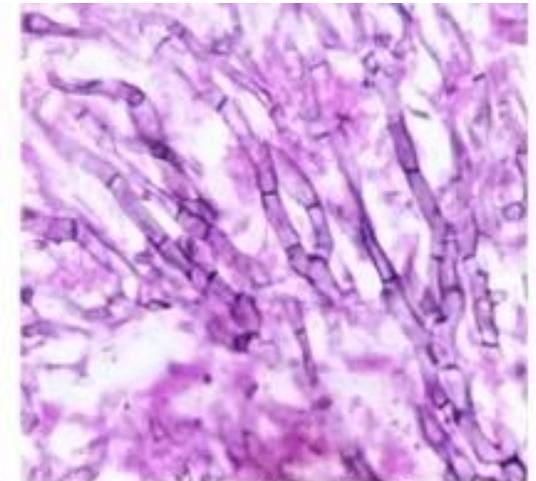
#### Culture:

- 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

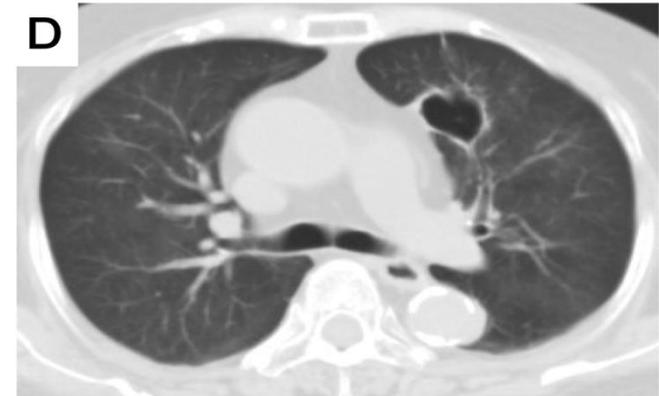
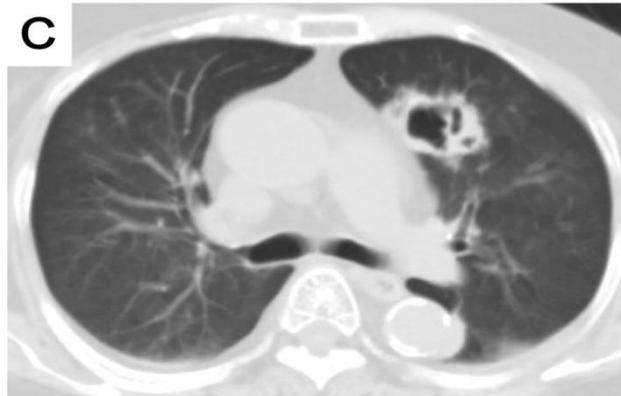
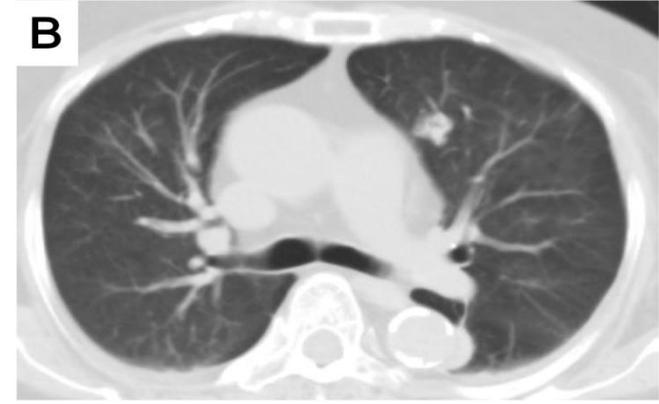
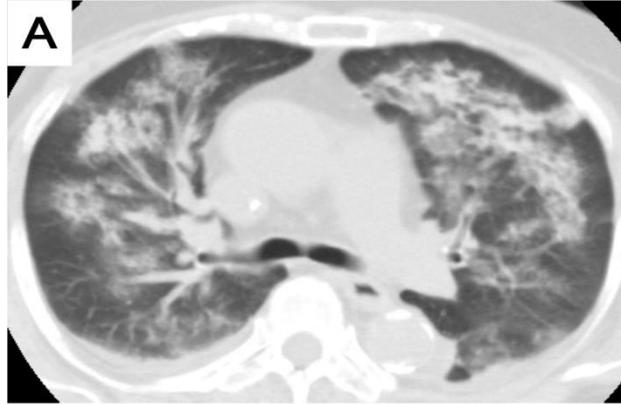
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Fungal hyphae in tissue

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.