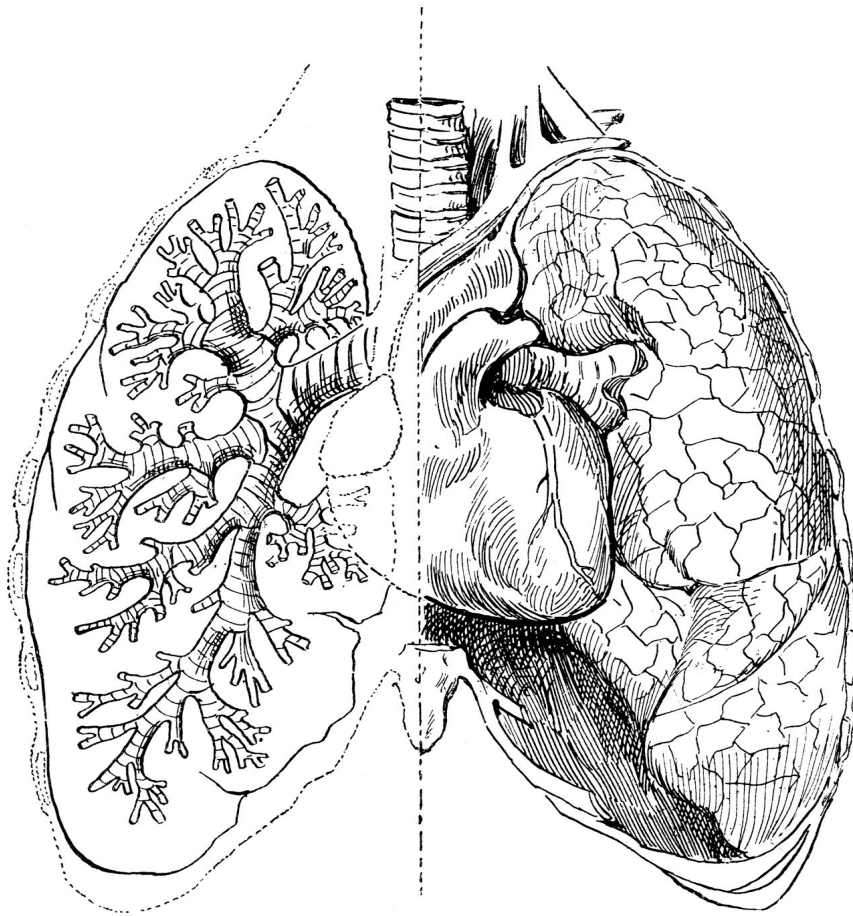


Microbiology

435's Teamwork
Respiratory Block



-
- Please contact the team leaders for any suggestion, question or correction.
 - Pay attention to the statements highlighted in **bold** and/or **red**.
 - **Footnotes color code:** General | **Females** | **Males**.

Microbiology.435@gmail.com

Respiratory Fungal Infections

- Lecture Five -

Learning Objectives:

- Know about **primary systemic mycosis**.
- Know about **Aspergillosis** and its classifications.
- Know about **fungal sinusitis**.
- Know about **Zygomycosis**.
- Know about **Pneumocystis**.

Introduction:

Fungal infections can affect the respiratory system by **inhalation of spores (airborne)** or through the oral route¹ (aspiration) or by septicemia or by VAP. Respiratory fungal infections are less common than viral and bacterial.

Etiology (Pathogen → Disease):

- **Yeast²: (opportunistic infection³)**
 - *Candida* → **Candidiasis**.
 - *Cryptococcus neoformans* and *gattii*⁴ → **Cryptococcosis**.
- **Mould fungi⁵: (opportunistic infection)**
 - *Aspergillus species* → **Aspergillosis**.
 - *Zygomycetes* like *Rhizopus* and *Mucor* → **Zygomycosis**.
- **Pneumocystis⁶: (opportunistic infection)**
 - *Pneumocystis jiroveci*.
- **Dimorphic fungi⁷: (primary infections⁸)**
 - *Histoplasma capsulatum* → **Histoplasmosis**.
 - *Blastomyces dermatitidis* → **Blastomycosis**.
 - *Paracoccidioides brasiliensis* → **Paracoccidioidomycosis**.
 - *Coccidioides immitis* → **Coccidioidomycosis (most infectious)**



¹ There are 74 different types of fungi in the oral cavity of a healthy person.

² فطر الخميرة
³ الالتهابات الانتهازية. يعيش المخلوق بشكل طبيعي غير ضار على جسم الإنسان إلى أن تضعف مناعته، فينتهز الفرصة ويسبب المرض.

⁴ Transmitted through the inhalation of spores from bird droppings, especially pigeons.

⁵ فطر العفن. عفن الخبز.

⁶ الالتهاب الرئوي.

⁷ Fungi which grows as mold in room temperature, and as yeast in the human body temperature. **They're highly infectious.** ([More](#))

⁸ على خلاف الالتهابات الانتهازية، تسبب مخلوقات هذا النوع المرض في الأشخاص سواء كانوا بمناعة ضعيفة أو أصحاء.

1) Primary Systemic Mycoses⁹:

They stand for infections of the respiratory system that occur by **inhalation**. It is common in North and South America, and less common in the rest of the world. The infection may **disseminate¹⁰ in immunocompromised** patients from the lungs to other organs.

Etiology:

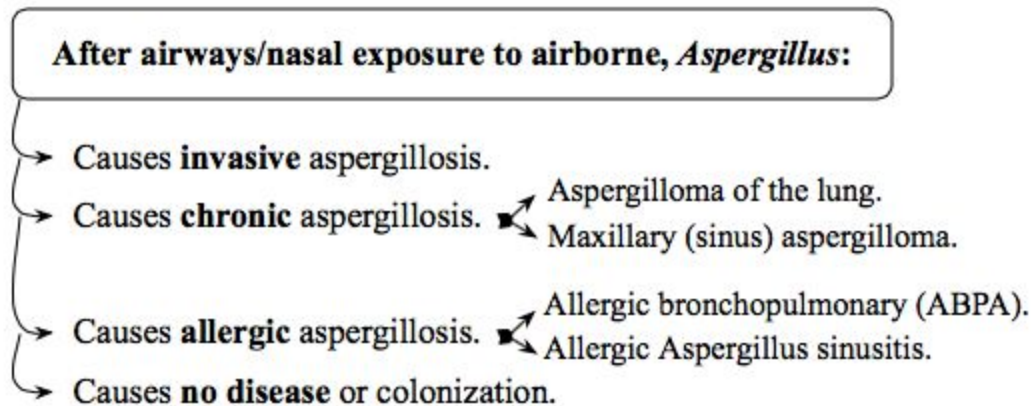
- Caused by **dimorphic fungi** which are found in soil¹¹.
 - **Primary** infectious.
 - They are considered as **highly infectious** pathogens.
-

2) Aspergillosis:

It is a **large spectrum of diseases** that occur in humans and animals, caused by the genus¹² ***Aspergillus*** of mould fungi (**opportunistic**).

These diseases include:

- Invasive diseases of the lungs.
- Mycotoxicosis¹³.
- Allergy¹⁴ usually type 2 hypersensitivity and may be type 1.
- Colonization (without invasion and extension) in body cavities.
- Systemic and disseminated disease¹⁵.



⁹ Very rare in KSA usually self limiting.

¹⁰ Spread.

¹¹ التربة
¹² الجنس؛ تصنيف الكائنات الحية (مملكة، فصيلة، جنس، نوع.) نناقش جنس الأسبيريجيلوس.

¹³ Diseases caused by the effects of toxins produced by *Aspergillus species*. ([More](#))

¹⁴ Can cause extrinsic bronchial asthma, remember?

¹⁵ Spread throughout an organ or the body.

Risk factors: Anything that could suppress the immune system is a risk factor¹⁶.

- **AIDS**
- **Bone marrow or organ transplantations.**
- **Cancers:** Leukemia, lymphoma... etc.
- **Drugs:** Cytotoxic drugs, steroids... etc.
- **Diabetes.**

Etiology:

Aspergillus species, the most common of them are:

- *Aspergillus fumigatus.*
- *Aspergillus flavus.*
- *Aspergillus niger.*
- *Aspergillus terreus.*
- *Aspergillus nidulans.*

Chronic Aspergillosis :

- Also called “**colonizing aspergillosis**”.
- Causes **Aspergilloma**¹⁷, which is also known as **aspergillus fungus ball.**
- Signs include: **Cough, hemoptysis**¹⁸, variable fever.
- Radiology will show a mass in the lung, radiolucent crescent¹⁹.

Invasive pulmonary Aspergillosis (Images next page):

- Signs include: **cough, hemoptysis, fever, leukocytosis**²⁰.
- Radiology will show lesions with a **halo**²¹ sign.

Allergic bronchopulmonary (ABPA):

- Symptoms: **asthma, bronchial obstruction**, wheezing, fever, malaise, **eosinophilia**²².
- Laboratory findings:
 - **Skin test** reactivity to Aspergillus.
 - Serum **antibodies** to Aspergillus.
 - **Serum IgE** > 1000 ng/ml.
 - **Pulmonary infiltrates.**

¹⁶ لأن هذه الفطريات تنتهز الفرصة (انتهازية) كما وضعنا.

¹⁷ A rounded collection of the organism, it can be seen on X-rays in pre-existing lung cavities. For more ([Here](#))

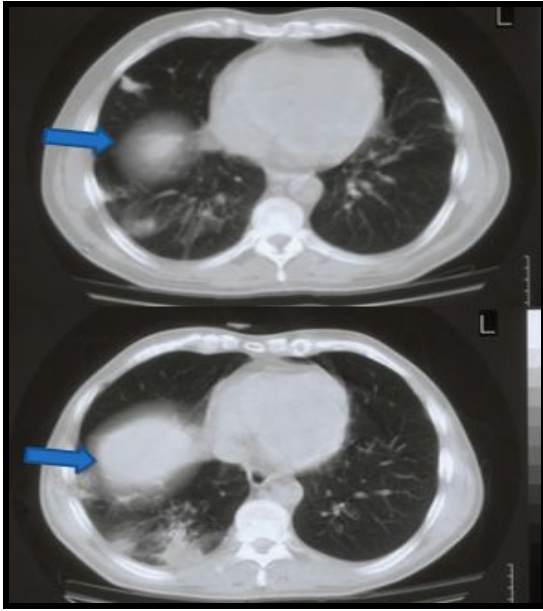
¹⁸ Coughing blood.

¹⁹ Radiographs that are associated with avascular necrosis. ([More](#))

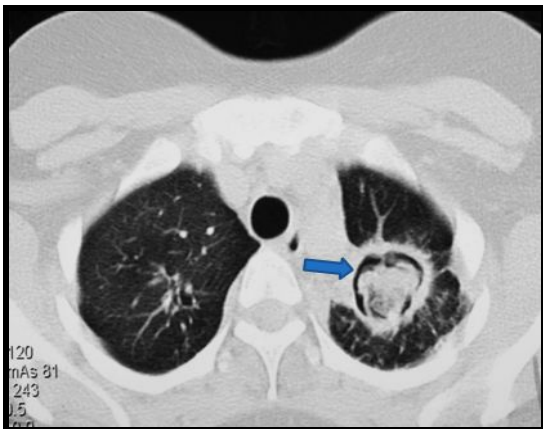
²⁰ Increase in the number of white cells in the blood.

²¹ A disk or circle of light.

²² Increase in the number of eosinophils in the blood. Study smart. Search for the reason why!

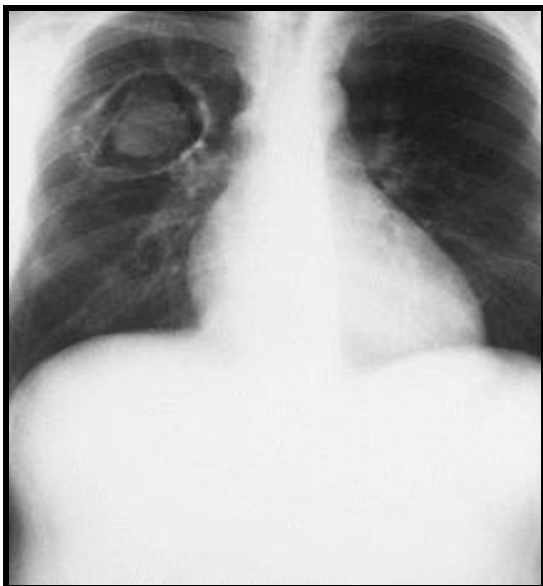


→ **Image 1:** Note the **halo sign**.



→ **Image 2:** Note the **Air crescent** (within a cavity).

To differentiate from cancer Aspergilloma is **moveable** in the cavity and cancer **cannot move**.



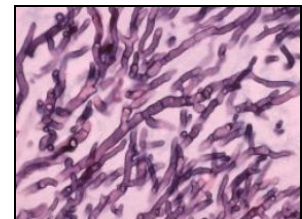
→ **Image 3.**

Fungal sinusitis:

- Caused by *Aspergillus* and other fungi.
- The most common cause in KSA is *Aspergillus flavus*.
- Occur In **immunocompromised** patients.
- **Symptoms:** **Nasal polyps**²³ and the usual sinusitis symptoms²⁴.
- Could disseminate²⁵ to the eye and cranium (**Rhinocerebral infection**²⁶).
- Aspergillus sinusitis has the same spectrum of Aspergillus diseases in the lung.
- **Diagnosis** of fungal sinusitis:
 - Clinical examination and radiological tests.
 - Culture.
 - Precipitating antibodies.
 - Measurement of IgE level.
 - RAST test.
- The **treatment** of fungal sinusitis **depends on the type** and **severity** of the disease, in addition to the **immunological status** of the patient.

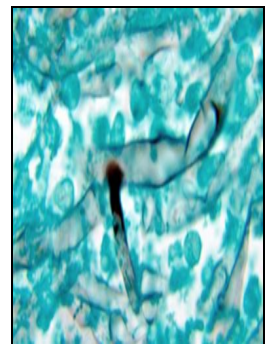
Diagnosis:

- **Specimen:**
 - **Respiratory specimens** → Sputum, BAL²⁷, Lung biopsy.
 - Other samples → Blood.
- **Laboratory Investigations:**
 - 1) Direct Microscopy.
 - Will show fungal **septate hyphae**.
 - **Giemsa Stain** or Grocott methenamine **silver stain** (GMS).
 - 2) Culture on SDA.
- **Serology:**
 - Test for **Antibodies**.
 - **ELISA**²⁸ test for galactomannan Antigen²⁹.
- **PCR**³⁰:
 - Detection of Aspergillus DNA in clinical samples.



Treatment:

- **Voriconazole**.
- Alternative therapy: Amphotericin B, **Itraconazole**, Caspofungin.



²³ Soft painful swellings.

²⁴ More ([Here](#))

²⁵ In the immunocompromised.

²⁶ Rare opportunistic infection of the sinuses. ([More](#))

²⁷ Bronchoalveolar lavage (washing).

²⁸ Uses chemicals to detect immune responses in the body. ([More](#))

²⁹ Aspergillus (Galactomannan) Antigen, used for detecting invasive aspergillosis.

³⁰ Polymerase chain reaction. Remember foundation's biochemistry OSPE?

3) Zygomycosis

It is a group of diseases caused by *Zygomycetes mould fungi* (opportunistic).

Divided into:

- **Pulmonary** zygomycosis.
- **Rhinocerebral** zygomycosis.

Pulmonary zygomycosis:

- **Acute** infection.
- **Rapid evolving** clinical course.
- Marked by **consolidation**³¹, **nodules**, **cavitation**, **pleural effusion**, **hemoptysis**.
- The infection may **extend** to the **chest wall**, **diaphragm**, or **pericardium**, causing pulmonary **infarctions** and **hemorrhage**³².
- Early recognition and **intervention** are critical.

Etiology:

- *Zygomycetes*.
- **Non-septate hyphae**, like *Rhizopus*.

Risk factors:

- Transplant patients.
- Malignancy.
- **AIDS**.
- **Diabetic ketoacidosis**³³.

Diagnosis:

- **Specimen:**
 - **Respiratory specimens** → Sputum, BAL, Lung biopsy.
- **Laboratory Investigations:**
 - 1) Direct Microscopy:
 - **Giemsa**, Grocott methenamine **silver stain (GMS)**.
 - Will show **broad non-septate fungal hyphae**.
 - 2) Culture on SDA: No cycloheximide³⁴.
- **Serology: Not available.**

Treatment:

- **Amphotericin B**.
- Surgery³⁵.

³¹ Uniting.

³² Can be fatal.

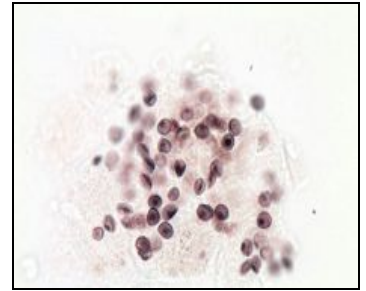
³³ A serious condition that can lead to diabetic coma. ([More](#))

³⁴ A protein that inhibits the growth of fungi. ([More](#))

³⁵ Debridement.

4) Pneumocystis

It is interstitial **pneumonia** of the alveolar area that affects **immunocompromised** hosts, which means that it is logically **common in AIDS** patients. It was previously thought to be a **protozoan parasite**³⁶, but later, it has been proven to be a fungus. This type of fungus is naturally found in rodents (rats), and other animals like goats and horses. Humans may have it during **childhood**³⁷.



Etiology:

Pneumocystis jirovecii.

Diagnosis:

Does not grow in laboratory media, like SDA for example.

- **Specimen:** Bronchoscopic specimens (BAL), Sputum, Lung biopsy tissue.
- **Histological sections or smears** stained by:
 - GMS stain.
 - **Immunofluorescence** (better sensitivity).
- If positive, will see **cysts** that are **hat-shaped**, cup-shaped, or crescent.

Treatment:

- **Trimethoprim**³⁸ + **Sulfamethoxazole**.³⁹
- Dapsone.

³⁶ Due to the resemblance in their ribosomal RNA.

³⁷ It is found naturally in the environment.

³⁸ Folic acid inhibitor antibiotic, it is administered because Pneumocystis Jirovecii **resists antifungals**.

³⁹ Both together are called (Trisulfa).



« قُلْ هَلْ يَسْتَوِي الَّذِينَ يَعْلَمُونَ وَالَّذِينَ لَا يَعْلَمُونَ »
سورة الزمر الآية ٩

Heartful thanks to Microbiology 435's Team

Leaders

Sara Alenezy Ali Alzahrani

Members

Fawzan alOtaibi
Areeb AlOgaiei
Dalal AlHuzaimi
Deema AlFaris
Elham Alzahrani
Ghaida Aljamili
Khawla Alammari
Kowthar almousa
Lina alshehri
Maryam Saidan
Nojood Alhaidri
Nouf Altwaijri
Norah Alkhayyal
Norah Alakeel
Nurah alqahtani
Ola alnuhayer
Samar AlOtaibi
Shahad Al-Enezi
Suha Alenazi
Reema Allhidan