Title : Mycology

*Definition :- The study of the mycoses infection of the man and their etiologic agents .

The diseases are caused by fungi

Mycotic diseases (fungal diseases) — manifestation — Subacute (indolent) / Subclinical / Insidious → No acute presentation

Allergies — Toxins — Fungal infections

Fungus

- Eukaryote
- Don't have chlorophyll (like plants and algi)
- Gain energy by Heterotrophic — Gain Carbon and nitrogen from
  - تحلل Decaying matter (Dead tissue) — Saprophytic
  - Living organisms — Parasitic (biotrophs)
  - From ammonia and nitrate
- Morphological forms
  - Yeasts → single cell
  - Molds → multicellular filamentous structures (hyphae) — خيط فطري
- Produce spores
  - Reproducing elements -Not like Bacteria for survival & resisting
  - Sexual production → teleomorphic fungi → Perfect status of fungi
  - ASexual production → anamorphic fungi → Imperfect status of fungi
    - Conidia → Induce hypersensitive type 1
  - Examples :- Blastospores / arthrospores / Vacedospores/ascospores/ Sphorules .
- Cell wall contain chitin & beta- glucan → Site of action of anti-fungal drugs
  - caspofem — Anti-fungal drug acts on glucan synthesis
- Cell wall contain ergosterol unlike animals that contain cholesterol → Site of action of some anti- fungal drug
  - Polyenes, Azoles, and Allyamines → Auti-fungal drugs that act on ergosterol synthesis
- Most are obligatory aerobe
  Some are facultative anaerobe
- Cause damage on crops and food chain
- Used in pharmaceutical industry (antibiotic)
  - penicillin
- Production of Food
- Few of fungi cause diseases (AIDS , Immune diseases) — opportunistic infections: more prone to develop fungal infections in immunocompromised patients.
  - mucormycosis (zygomycosis) may develop in diabetic patients.

Fungal Cell wall:

- Contain chitin, beta- glucan , mannas
- Anti-phagocytic

*Plasma membrane contain phospholipids & ergosterol

KOH → used to digest human tissues

Fungi — According to growth forms

- Monocellular
- Multicellular
- Have branching tubular filaments (hyphae) — Filamentous fungi (Molds)
  - Have mycelium
  - Network of hyphae
  - Produce asexual spores
  - Produce sporangiospores
  - Example
    - Zygomycete
      - causes a disease called mucormycosis.
      - 3 species
        - Rhizopus
        - mucor
        - Absidia
    - Aspergillus
      - 3 species
        - Aspergillus fumigatus — fungal allergies
        - Aspergillus flavus — Cause Aspergillosis (in lungs)
        - Aspergillus parasiticus
      - WBC
      - Blood clots
      - Fungus fibers
    - Dermatophytes
      - Cause Tinea diseases — Skin infection
      - 3 species
        - Epidermophyton
        - Microsporum
        - Trichophyton
- True pathogens — Dimorphic fungi
  - 2 forms
    - Reversible
    - Molds — Temperature : 22 °
    - Yeasts — In tissues Temperature: 37 °
    - Blastomyces dermatitidis — Cause blastomycosis
    - Coccidioides immitis — Cause coccidioidomycosis
    - Histoplasma capsulatum — Cause histoplasmosis
    - Paracoccidioides — Cause Paracoccidioidomycosis
    - Sporothrix — Rose gardeners disease — Cause sporotrichosis
    - Examples
    - Key factor :- Temperature

Yeasts

- Single cell
- Candida → love candy
- Shape :- oval or round
- Method of reproduction :budding
  - The difference between budding and division
    - Budding : The daughter cell smaller in size than mother Cell
    - Division: The daughter cell has the same size of the mother cell
  - Chain of elongated budding cell
- Producing pseudohyphae
  - Incomplete budding → Cell elongate but remain attached
- Example:
  - Candida albicans
    - Caused infection in immunocompromised patient → candidiasis
    - opportunistic organisms
    - Normal flora in skin , GIT and Vagina
    - Manifestations
      - AIDS
      - Oral trash → Fungal infection on the mouth
    - Cutaneous candidiasis leads to candida creases (armpit) — ابط
    - Candida can cause meningitis, arthritis and respiratory infections. — الجهاز العصبي
    - Exogenous in sexual contact
  - cryptococcus neoformans
    - Not Normal flora (exogenous) — From soil and pigeons feces
    - Always pathogenic
    - Have capsule
    - Infect the lungs
    - Infect through
      - Inhalation
      - Spores
      - Ingestion

Diagnosis

- Clinical investigation
  - The first indication that a patient may have a systemic mycosis, is often their failure to respond to antibacterial antibiotics .
- Laboratory diagnosis
  - *Recognition of the pathogen in tissue by microscopy
  - *Isolation of the causal fungus in culture
  - *The use of serological tests
  - *Detection of fungal DNA by PCR.

Types of specimen

- To diagnose ringworm
  - Specimen: Skin scales, nail clippings and scrapings of the scalp that include hair stubs and skin scales
  - Method: The specimen is collected into folded paper squares for transport to the laboratory.
- To diagnose Candida infections
  - Specimen: Swabs from mucous membranes
- To diagnose subcutaneous infections
  - Specimen: Scrapings and crusts
- To diagnose systemic infections
  - Specimen: From appropriate sites like lungs

Fungal diseases

- Fungal allergies
  - Examples
    - Extrinsic allergic alveolitis
    - Allergic rhinitis — Type of inflammation in nose
    - Asthma — bronchoconstriction
  - Seen in farmers
  - Caused by → Aspergillus fumigates
  - Manifestations
    - Asthmatic reaction — Mediated by IgE
    - Eosinophilia
    - Producing by
      - *Inhaled spores
      - *Volatile fungal toxins
- Fungal toxins (mycotoxicosis)
  - Main group :- Aflatoxin — Metabolized in liver
    - Aflatoxin B1 — Cause potent hepatocellular carcinogen — Mutation in p53 gene
  - Example:- aflatoxicosis
    - Caused by
      - Aspergillus flavus
      - Aspergillus parasiticus
    - Results from ingestion of aflatoxins in food
- Fungal infections (mycoses)
  - Classification
    - Superficial & cutaneous
      - Infections involve the skin (dead, keratinized layer), mucous membranes, nail or hair.
      - Superficial
        - Pityriasis versicolor
        - Tinea nigra
        - white piedra
        - black piedra
      - Cutaneous
        - cutaneous candidiasis
        - Tinea by Dermatophytes
    - Subcutaneous
      - Location
        - Cornea
        - Muscles
        - Joints
      - Examples
        - Chromoblastomycosis — Caused by fonsecaea pedrosoi
        - Sporotrichosis — Caused by Sporothrix schenckii
        - Madura foot — Caused by madural mycetomatis
    - Systemic (endemic) mycoses
      - Caused by dimorphic fungi
      - Example
        - coccidioidomycosis
        - histoplasmosis
        - paracoccidioidomycosis
        - blastomycosis
    - Opportunistic Mycoses
      - Examples
        - Candida
        - Cryptococcus

Stains and Examination

- Examination by adding wet amount of KOH (10-20%)
- Stains
  - Universal stain
    - Calcofluor white — Fluorescent hydroxide- Calcofluor binds to the fungal cell walls (chitin)
  - Special stain
    - India Ink — Stain outer capsule of cryptococcus neoformans
    - *Methylene blue
    - *Lactophenol blue
    - *Periodic acid-Schiff (PAS)
    - *Ink
    - *Gram stain.

Culture

- Sabouraud dextrose medium
  - inhibits bacterial growth (except for contaminants)
  - supplemented with
    - to minimize bacterial contamination — Chloramphenicol
    - to reduce contamination with saprophytic fungi — Cycloheximide

Autifungal therapy

- Polyenes
  - Fungicidal
  - Bind to the ergosterol
  - Examples
    - Amphotericin B — Given IV in case endemic mycoses and opportunistic mycoses
    - Nystatin
      - Topical — cream, solution... In case skin infection
- Azoles
  - Fungistatic → inhibition the synthesis of ergosterol
  - Examples
    - *Ketoconazole
    - *Fluconazole
    - *Itraconazole
    - *Voriconazole
    - *Posaconazole
- Allylamines
  - Fungistatic
    Inhibition the enzyme for ergosterol synthesis → squalene epoxidase .
  - Example: Terbinafine
- Griseofulvin
  - Fungistatic
  - Given in case superficial mycotic
- Echonocandins
  - Fungistatic :- Inhibition Beta glucans synthesis
  - Examples
    - Caspofungin — Given in case dermatophytosis (superficial and cutaneous)
- 5-flourocytosine (5-FC) F
  - Fungistatic
  - Inhibition of DNA and RNA synthesis
  - Given to cancer