

*F*UNGI

# Mycology

**FUNDAMENTALS, DIAGNOSIS AND  
TREATMENT**



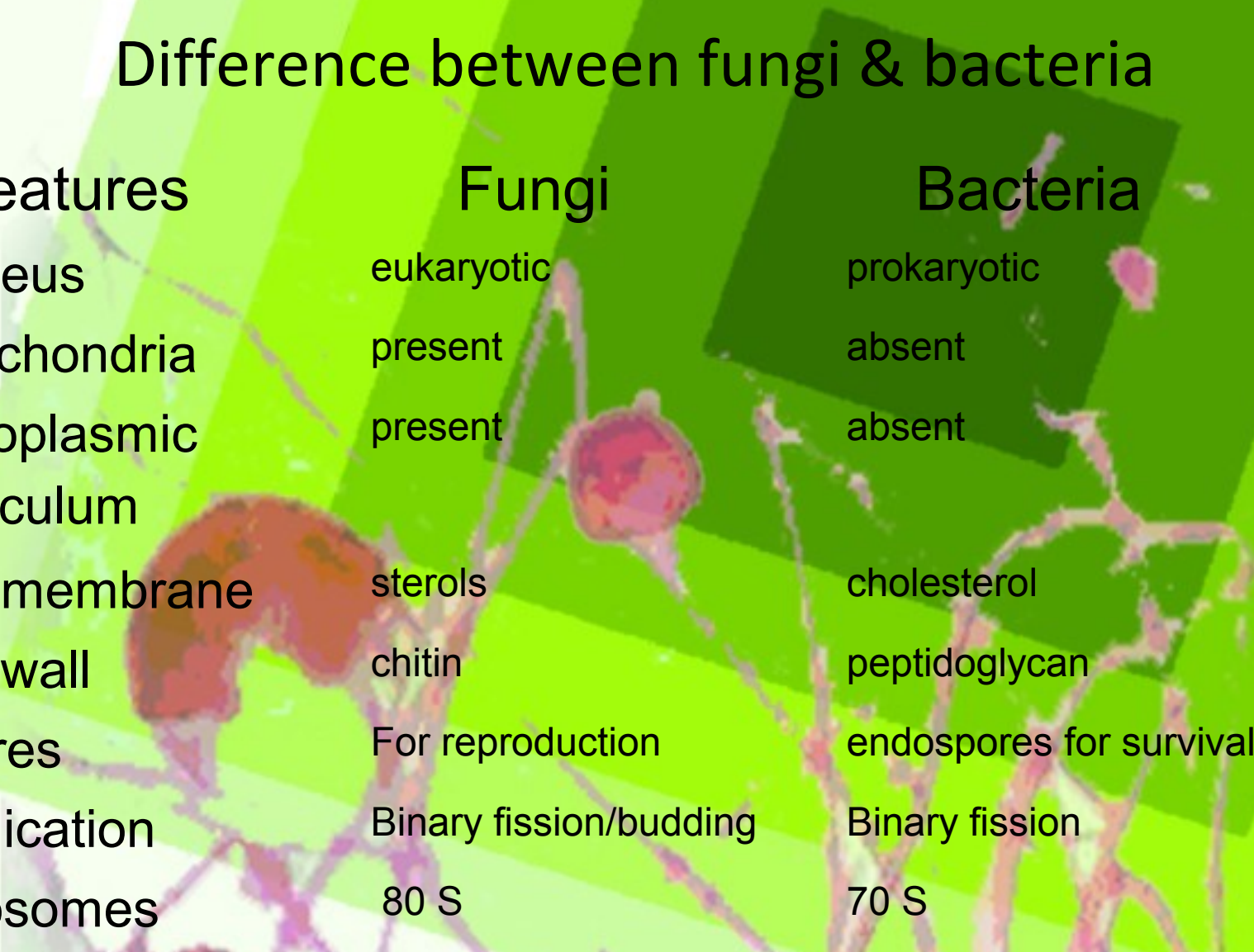
# FUNGAL INFECTIONS

- The study of fungi is known as **mycology** and scientist who study fungi is known is a **mycologist**
- A fungus is a member of a large group of **eukaryotic organisms**
- Over 60,000 species of fungi are known .
  - They are normally harmless to humans
  - Fungi can be opportunistic pathogens.

# General Characteristics:

- All are obligate aerobes, some are facultative anaerobes
- > all fungi are gram (+)
- > natural habitat is the environment
- **Fungal** cell wall contain **chitin** but **plants** cell wall has **cellulose**.

# Difference between fungi & bacteria

The background of the slide features several microscopic images. On the left, there are images of fungi, including a large, reddish, multi-lobed structure and a smaller, spherical, pinkish structure. On the right, there are images of bacteria, including a long, thin, pinkish rod and a smaller, pinkish, irregularly shaped structure. The text is overlaid on a semi-transparent green background.

Features	Fungi	Bacteria
Nucleus	eukaryotic	prokaryotic
Mitochondria	present	absent
Endoplasmic reticulum	present	absent
Cell membrane	sterols	cholesterol
Cell wall	chitin	peptidoglycan
Spores	For reproduction	endospores for survival
Replication	Binary fission/budding	Binary fission
Ribosomes	80 S	70 S

# Morphologic Forms of Fungi

## A. Yeast

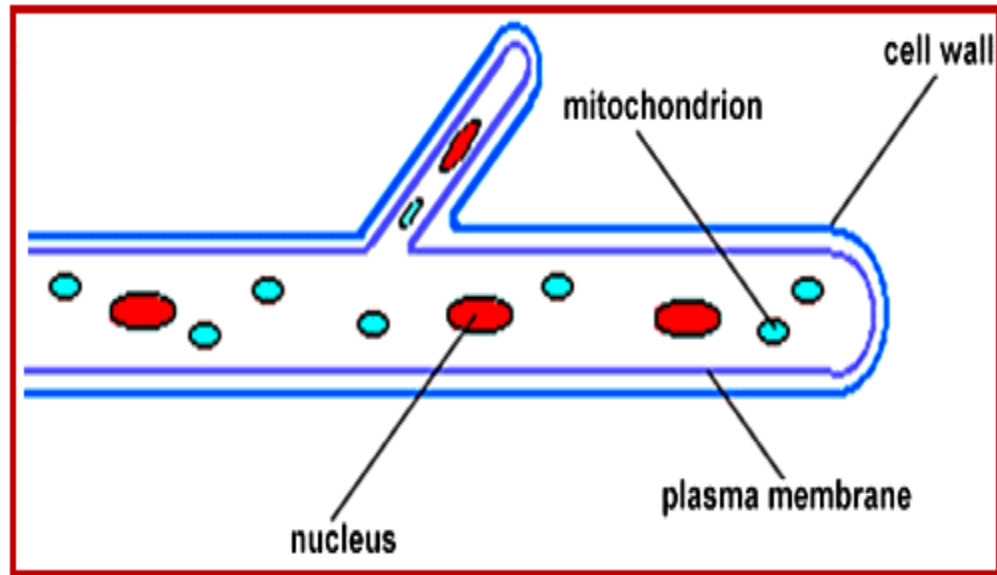
- grow as single cells
- round to oval in shape aprox. 3-8 $\mu$ m indiameter.
- are reproduced asexually by the process termed as

1. fission formation

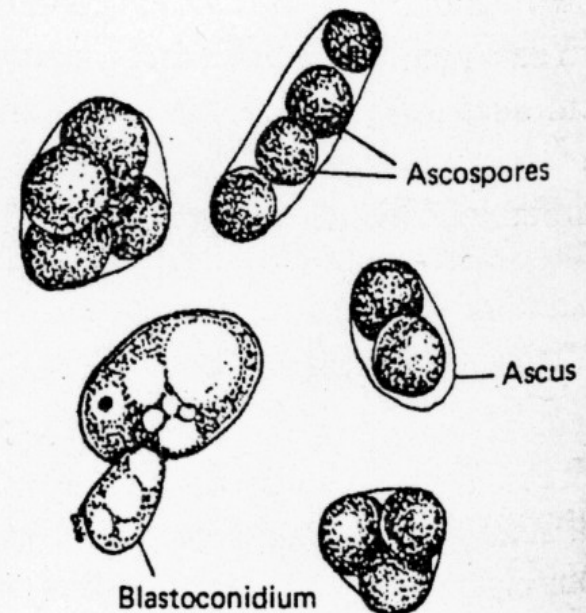
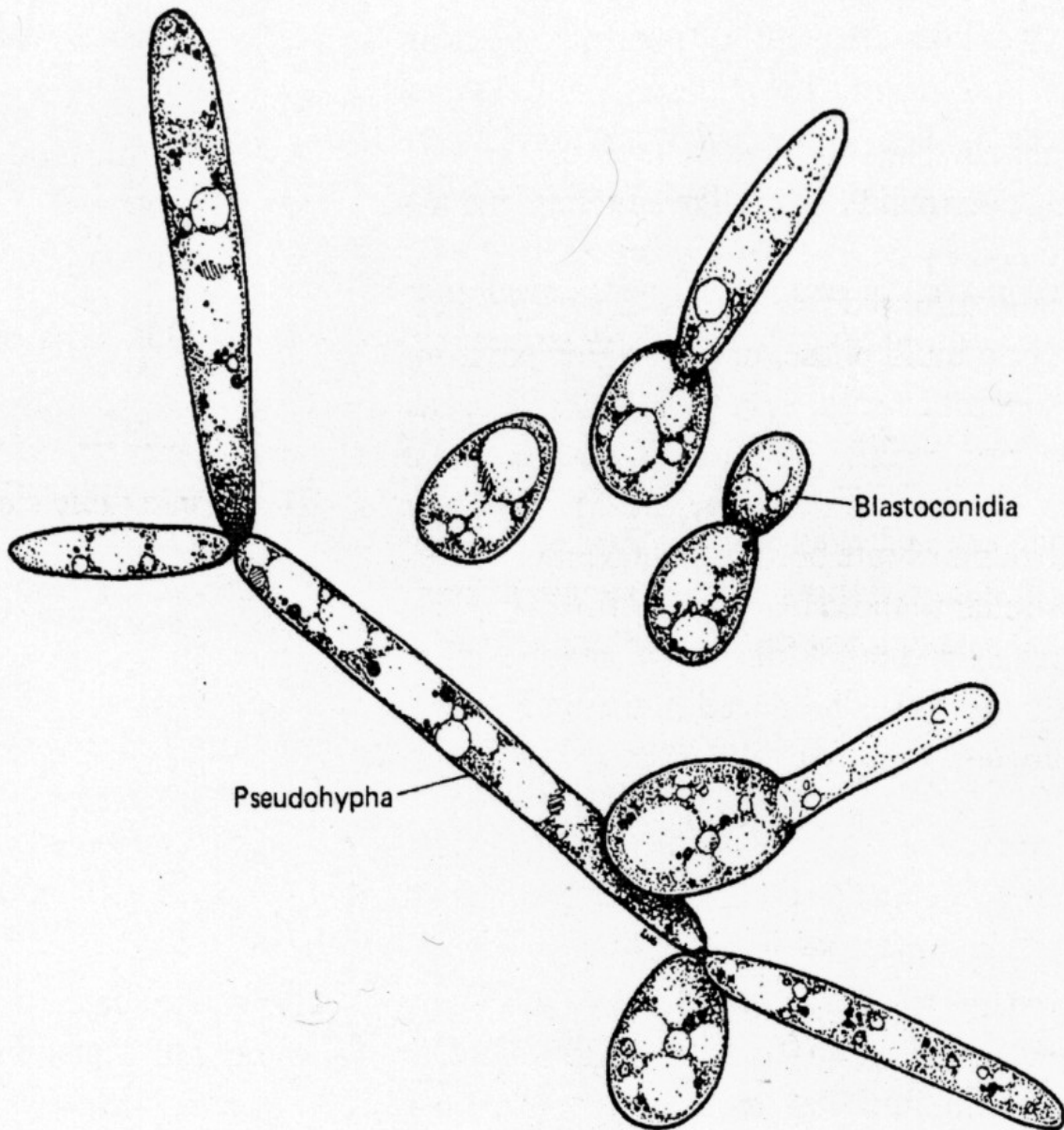
2. blasto-conidia formation  
(budding)

# Single Hyphae

- Structure

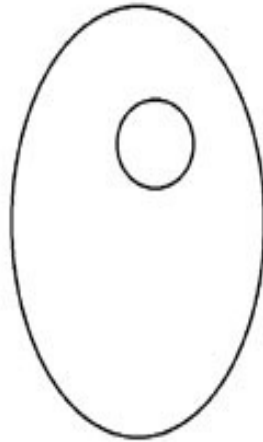


# Yeast form

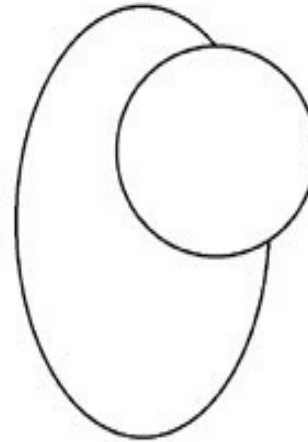


# ..Reproduction in yeast

- -



Ring of chitin synthesized around area where bud will extrude.



New bud forced out from plasticised cell wall.

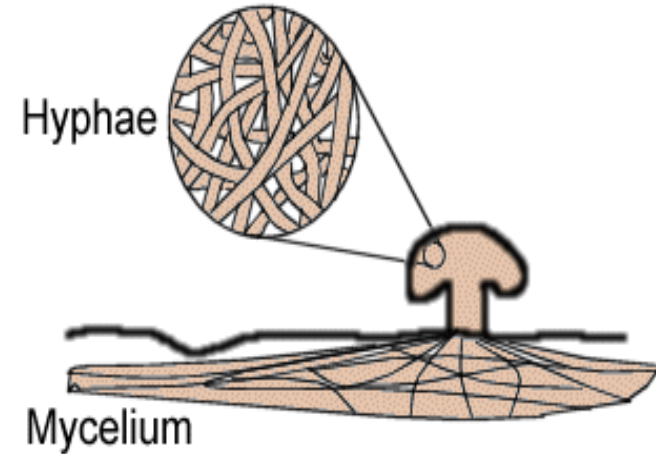


## B. Moulds

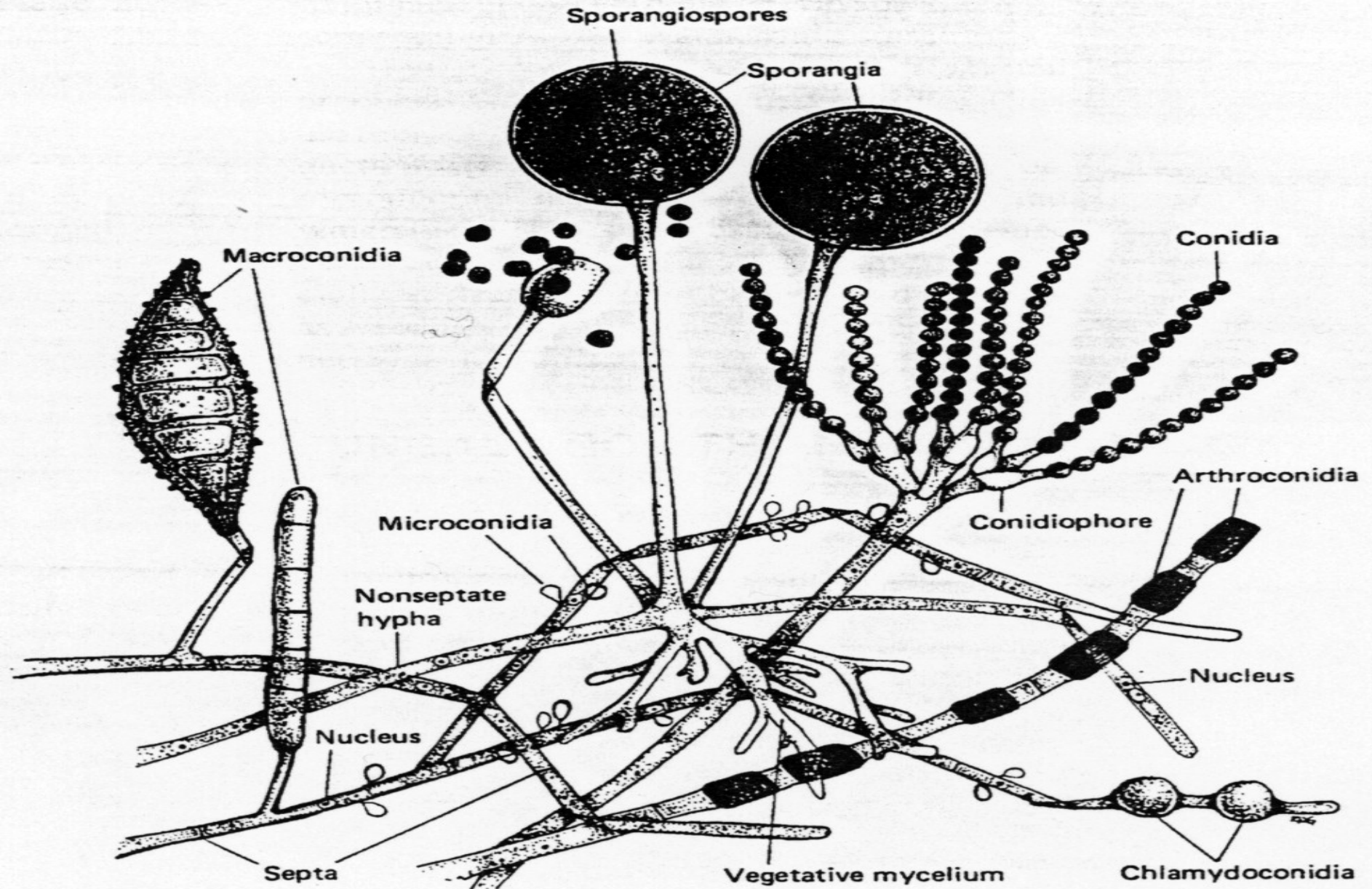
Molds are filamentous.  
Filaments are called **hyphae**.

They arise from fungal  
**conida or spores** that send  
out a germ tube.

Mould colonies are  
composed of masses of  
hyphae, collectively called  
**mycelium**. **Aerial** and  
vegetative mycelium is seen.



# Mould form



## DIMORPHIC FUNGI

can exist in 2 forms:

*a.* tissue phase- yeast phase

*b.* mycelial or filamentous  
phase

- Paracytic fungi are called mycotic agents.

Monomorphic		dimorphic	
Mould	yeast	phenotypic dimorphs	Thermal
Microsporium	cryptococcus	Candida	blastomyces
Tricophytone			
Aspergillus		geotrichum	
Penicilium			histoplasma
zygomycetes			

# FUNGAL DISEASES

## I. Fungal allergies

## *II. Mycotoxicosis*

- potent toxins produced

a. phalloidin

c. ergotism

b. Amanitin

d.

Aflatoxin

## *III. Fungal Infections*

# YEASTS AND MOULDS

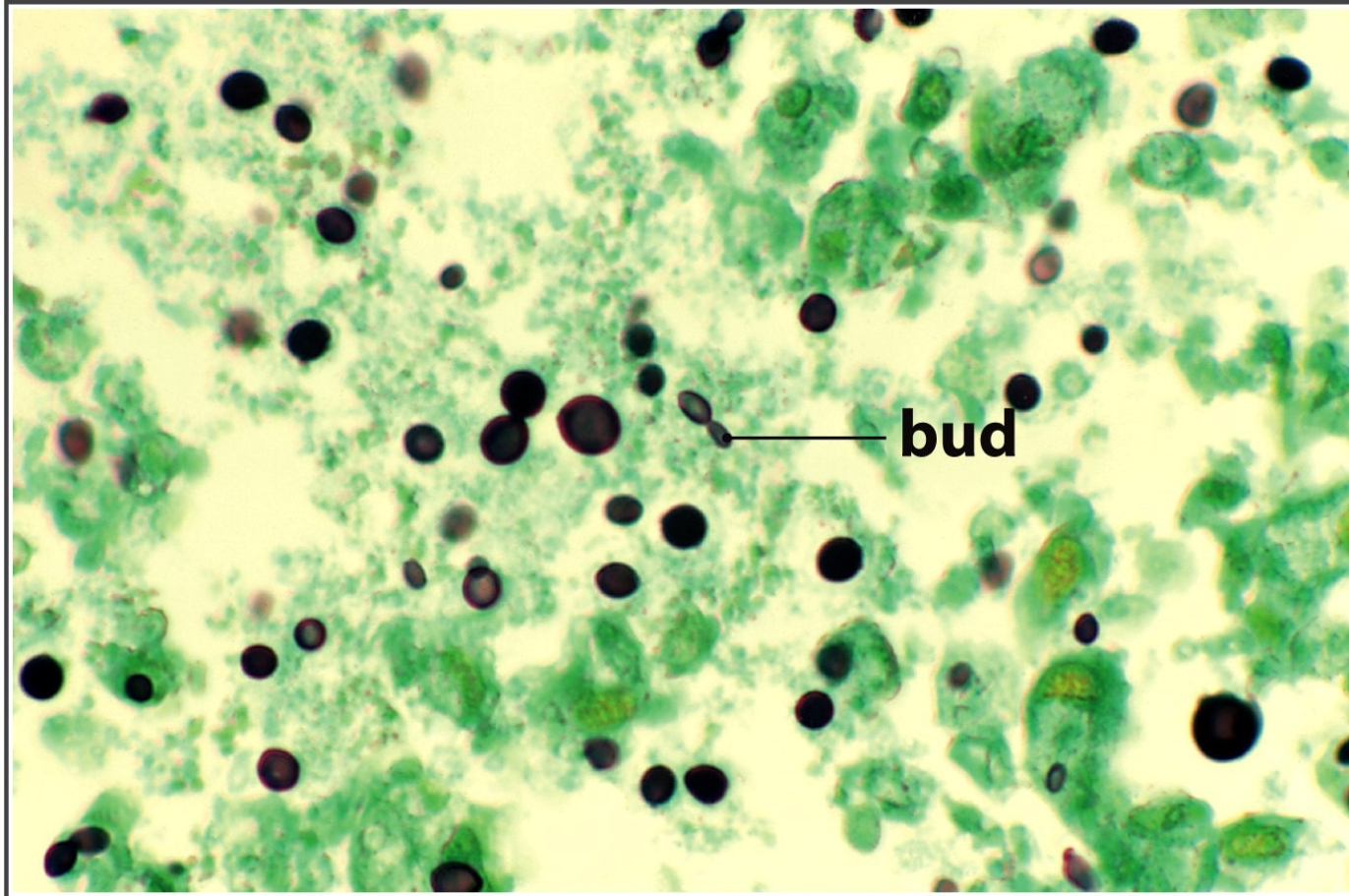


Figure 14.16 Microbiology: A Clinical Approach (© Garland Science)

© CDC/ Dr. Edwin P. Ewing, Jr.

# YEASTS AND MOULDS

- Moulds – multicellular
- Yeasts – unicellular
- The simplest form of growth is budding.
  - Buds are called **blastoconidia**.
  - Seen in yeasts.

**moulds** are described as **aerobic**,

**yeasts** are able to grow **facultatively**

a. Under **anaerobic** condition, glucose can be converted

to alcohol and CO<sub>2</sub> via the

**Embden-Meyerhoff pathway**

b. Under **aerobic** condition, glucose can be oxidized

completely to CO<sub>2</sub> & H<sub>2</sub>O by some yeast via the

**Citric Acid Cycle**



# Reproduction

- **Sexual and asexual.**
- Asexual- spores formation, budding, binary fission.
- Sexual- Life cycle involves the fusion of hyphae from two individuals (Male & Female)
- Each parent hyphae has haploid nuclei
- The fusion of hyphae is called **plasmogamy**.

# Classification of Fungi

## By Reproductive Structures

### Oomycetes

- Water Moulds
- Motile sexual spores
- Example: Potato blight *Phytophthora*

# .....Classification of Fungi

## Zygomycetes

- Unenclosed zygospores produced at ends of hyphae
- Example: Black bread mold *Rhizopus*

## Ascomycetes

- **Ascospores** are enclosed in **asci** (sac-like structures) at the ends of hyphae or yeasts
- Examples: *Penicillium*, *Saccharomyces*

# .....Classification of Fungi

## Basidiomycetes

- Basidiospores are produced on a club-shaped structure called a **basidium**
- Example: Mushrooms, *Cryptococcus*

## Deuteromycetes

- “Imperfect fungi”
- No sexual stage is known for these fungi
- **Many parasitic fungi fall into this class**
- Examples: *Candida*, *Epidermophyton*

# Common Fungal Diseases according to frequency

:

- Candidiasis
- Dermatomycoses
- Respiratory Fungal Infections

# CLASSIFICATION OF PATHOGENIC FUNGI

Fungal diseases are classified into 4 groups:

- Superficial mycoses
- Mucocutaneous mycoses
- Subcutaneous mycoses
  - Deep mycoses

Superficial mycosis also known as Dermatormycosis.

- Mainly 3 types of fungi-
- **Microsporum**
- **Tricophyton**
- **Epidermophyton.**

# SUPERFICIAL MYCOSES

- Fungal infections that do not involve a tissue response:
  - **Piedra** – colonization of the hair shaft causing black or white nodules
  - **Tinea nigra** – brown or black superficial skin lesions
  - **Tinea capitis** – folliculitis on the scalp and eyebrows



# ...SUPERFICIAL MYCOSES

- **Favus** – destruction of the hair follicle.
- **Pityriasis** – dermatitis characterized by redness of the skin and itching:
  - Caused by hypersensitivity reactions to fungi normally found on skin
  - Mostly seen in immunocompromised patients.



Copyright © 2003 Elsevier - Pediatric Dermatology 3E, edited by Schachner, Hansen et al. All rights reserved.

- **Black dot tinea**

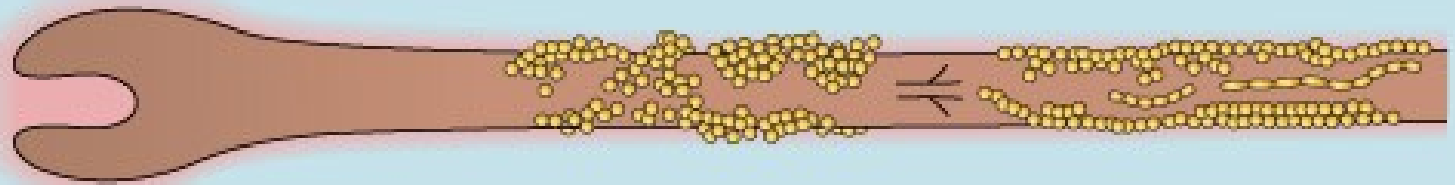
# Favus with scarring alopecia and scutula



## THE THREE PATTERNS OF HAIR INVASION AND THE CAUSATIVE DERMATOPHYTES

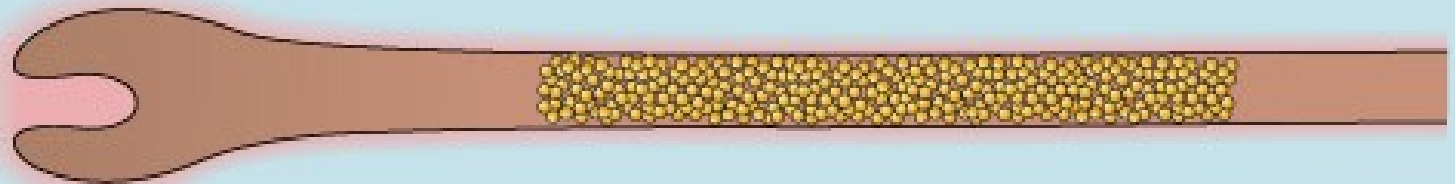
### Ectothrix

*M. canis*\*  
*M. audouinii*\*  
*M. ferruginosum*\*  
*M. distortum*\*  
*M. gypseum*  
*T. rubrum* (occasionally)



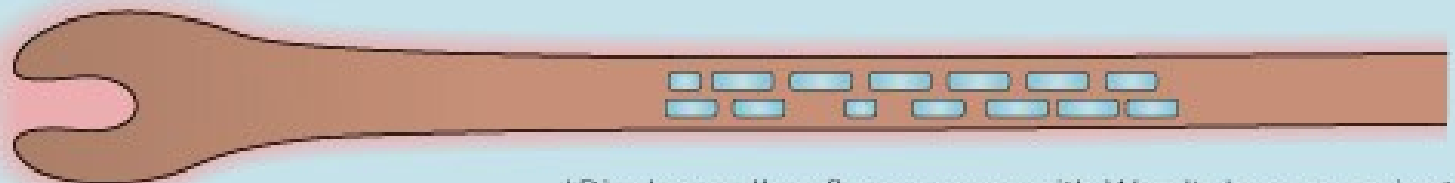
### Endothrix

*T. tonsurans*  
*T. violaceum*  
*T. soudanense*  
*T. gourvilli*  
*T. yaoundei*  
*T. rubrum* (occasionally)



### Favus

*T. schoenleinii*\*



● Arthroconidia  
▭ Hyphae and air spaces

\*Displays yellow fluorescence with Wood's lamp examination

- Majocchi's granuloma: PAS reveals multiple organisms that have replaced a fragment of hair shaft embedded in a sea of neutrophils

# CUTANEOUS AND MUCOCUTANEOUS MYCOSES

- Associated with:
  - Skin
  - Eyes
  - Sinuses
  - Oropharynx and external ears
  - Vagina

# ...CUTANEOUS AND MUCOCUTANEOUS MYCOSES

**Ringworm** – skin lesions characterized by red margins, scales and itching:

- Classified based on location of infection
  - **Tinea pedis** – on the feet or between the toes
  - **Tinea corporis** – between the fingers, in wrinkles on the palms
  - **Tinea cruris** – lesions on the hairy skin around the genitalia
    - **Tinea capitis** – scalp and eyebrows
- **Onychomycosis** – chronic infection of the nail bed
  - Commonly seen in toes
- **Hyperkeratosis** – extended scaly areas on the hands and feet

# ...CUTANEOUS AND MUCOCUTANEOUS MYCOSES

- **Mucocutaneous candidiasis** – colonization of the mucous membranes
  - Caused by the yeast *Candida albicans*
    - Often associated with a loss of immunocompetence
  - **Thrush** – fungal growth in the oral cavity
    - An indicator of immunodeficiency.
  - **Vulvovaginitis** – fungal growth in the vaginal canal
    - Can be associated with a hormonal imbalance



# CUTANEOUS MYCOSIS



# ..CUTANEOUS AND MUCOCUTANEOUS MYCOSES



Figure 14.20 Microbiology: A Clinical Approach (© Garland Science)

# CUTANEOUS MYCOSIS



# Tinea unguium



- Invasion of nail plate by dermatophytes
- Thickened, discolored & brittle
- Onychomycosis- non dermatophyte
- Yeast etc.



# Tinea pedis



- Athlete's foot
- Toe webs & soles, even nails
- Id reaction, circulating fungal antigens

# Tinea cruris



- Jock itch
- Moist groin area
- *E. floccosum*,  
*T. rubrum*

# Tinea Barbae

- AKA Tinea sycosis, barber's itch
- Uncommon
- Occurs chiefly among those in agriculture
- Involvement is mostly one-sided on neck or face
- Two clinical types are:
  - **deep**, nodular, suppurative lesions; and
  - **superficial** , crusted, partially bald patches with folliculitis

# Tinea barbae



- **Bearded areas of face & neck**







- Tinea barbae-*Trichophyton mentagorphytes*



- Tinea faciei  
(*Microsporum canis*)  
in a child

# SUBCUTANEOUS MYCOSES

Localized primary infections of subcutaneous tissue:

- Can cause the development of cysts and granulomas.
- Provoke an innate immune response - **eosinophilia.**

# ...SUBCUTANEOUS MYCOSES

There are several types:

- **Sporotrichosis** – traumatic implantation of fungal organisms
- **Paranasal conidiobolae mycoses** – infection of the paranasal sinuses
  - Causes the formation of granulomas.
- **Zygomatoc rhinitis** – fungus invades tissue through arteries
  - Causes thrombosis
  - Can involve the CNS.

# SUBCUTRNEOUS MYCOSIS



# SUBCUTRNEOUS MYCOSIS



# DEEP MYCOSES

**Deep mycoses** Usually seen in immunosuppressed patients with:

- AIDS
- Cancer
- Diabetes

•Can be acquired by:

- Inhalation of fungi or fungal spores
- Use of contaminated medical equipment

•**Deep mycoses** can cause a systemic infection – disseminated mycoses

- Can spread to the skin



# ..DEEP MYCOSES



Figure 14.21 Microbiology: A Clinical Approach (© Garland Science)

# Congenital candidiasis





Copyright © 2003 Elsevier - Pediatric Dermatology 3E, edited by Schachner, Hansen et al. All rights reserved.

# ..DEEP MYCOSES

**Coccidiomycoses** – caused by genus *Coccidioides*

- Primary respiratory infection
- Leads to fever, erythremia, and bronchial pneumonia
- Usually resolves spontaneously due to immune defense
  - Some cases are fatal

# ...DEEP MYCOSES

**Histoplasmosis** – caused by *Histoplasma capsulatum*

- Often associated with immunodeficiency
  - Causes the formation of granulomas
    - Can necrotize and become calcified
- If disseminated, histoplasmosis can be fatal.

## ...DEEP MYCOSES

**Aspergillosis** – caused by several species of *Aspergillus*

- Associated with immunodeficiency
- Can be invasive and disseminate to the blood and lungs
  - Causes acute pneumonia
  - Mortality is very high.
- Death can occur in a matter of weeks.

# Respiratory Fungal Infections

## Cryptococcosis

- *Cryptococcus neoformans*
- *Histoplasmosis*
- *Histoplasma capsulatum*
- *Blastomycosis*
- *Blastomycosis dermatitis.*

# **ORAL FUNGAL INFECTION**



## Common oral fungal diseases

- Candidiasis
- Histoplasmosis
- Blastomycosis (north American)
- Paracoccidioidomycosis(south American blastomycosis)
- Coccidioidomycosis
- Cryptococcosis
- Zygomycosis/mucormycosis
- Aspergillosis
- geotricosis

# CANDIDIASIS

- Refers to infection with yeast like fungal organism.
- Most common oral fungal infection.
- It is a component of normal oral flora.
- Can occur in persons who are debilitated by other diseases or in otherwise healthy individuals also.

# PREDISPOSING FACTORS-

a) **local**- Mucosal trauma

- Denture wearers
- Denture hygiene
- Tobacco smoking
- Carbohydrate rich diet
- Drugs (Broad spectrum antibiotics, steroids, immunosuppressant / cytotoxic agents)
- Xerostomia

## ***b) Systemic factors :***

- Iron deficiency anaemia
- Megaloblastic anaemia
- Acute leukaemia
- Diabetes mellitus
- HIV infection
- Other immunodeficiency states

# CLASSIFICATION OF CANDIDIASIS: -

## *Group 1 (Conditions confined to the oral mucosa):*

### *Acute -*

- Acute pseudomembranous candidiasis(thrush)
- Acute atrophic candidiasis

### *Chronic -*

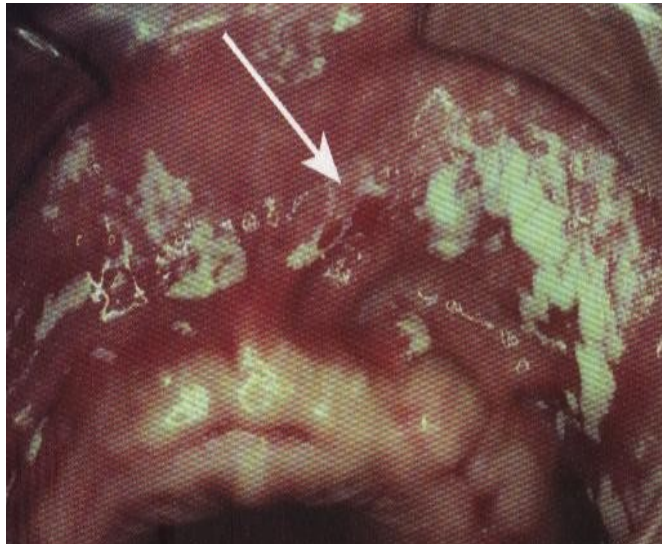
- Chronic atrophic candidiasis
- Candida associated angular cheilitis
- Chronic hyperplastic candidiasis

## *Group 2 (oral manifestations of generalized candidiasis)*

- Chronic mucocutaneous candidiasis

# ACUTE PSEUDOMEMBRANEOUS CANDIDIASIS (THRUSH)

- Best recognized form of candidiasis.
- Characterized by development of white plaques that can be **scraped off** with tongue blade.
- Can be initiated by broad spectrum antibiotics or immune dysfunction.



Occurs characteristically on buccal mucosa, palate and dorsal tongue.

Usually asymptomatic or patients may c/o burning sensation of mucosa or unpleasant taste in mouth. Can occur in infants also.

# ATROPHIC CANDIDIASIS

(Erythematous candidiasis)

- Several presentations seen –
  1. Acute atrophic candidiasis
  2. Median rhomboid glossitis
  3. Chronic multifocal candidiasis
  4. Angular cheilitis
  5. Chronic atrophic (denture sore mouth) candidiasis



# 1. ACUTE ATROPHIC CANDIDIASIS



Also called “*antibiotic sore mouth*”, as it follows course of broad spectrum antibiotics.

Patients c/o burning sensation of mucosae.

Seen as diffuse loss of filiform papillae resulting in a bald appearance of tongue

## **2. MEDIAN RHOMBOID GLOSSITIS**



Also called central papillary atrophy of tongue.

Well demarcated erythematous zone affecting midline of dorsum of tongue.

Often asymptomatic.

Erythema due to loss of filiform papillae.

Sometimes, other areas of oral cavity like hard palate and angles of mouth also show lesions (*Chronic multifocal candidiasis*).



**. CHRONIC ATROPHIC  
CANDIDIASIS:**



Characterized by varying degrees of erythema in denture bearing areas of usually maxillary prostheses.

Usually asymptomatic. Patients give h/o wearing denture continuously.



#### 4. **ANGULAR CHEILITIS**: -



- Also called perleche.
- Characterized by erythema, fissuring and scaling of corners of mouth.
- Typically occurs either along with multifocal candidiasis or in old patients with reduced vertical dimension.
- Saliva pools in these areas, keeping them moist and thus favoring fungal infection





## **5. CHRONIC HYPERPLASTIC CANDIDIASIS:**

Least common of all types.

Appears as non scrapable white patch resembling leukoplakia (*candidal leukoplakia*)

Believed that it represents candidiasis superimposed on pre-existing leukoplakia.

Diagnosis confirmed by demonstration of candidal hyphae within the lesion and resolution of lesion after antifungal therapy.



- Chronic Hyperplastic Candidiasis has more potential for malignant transformation.
- Study shows CHC with dysplasia has resolved within 11 days of systemic triazole antifungal. Infected leukoplakia has greater chance of malignancy.



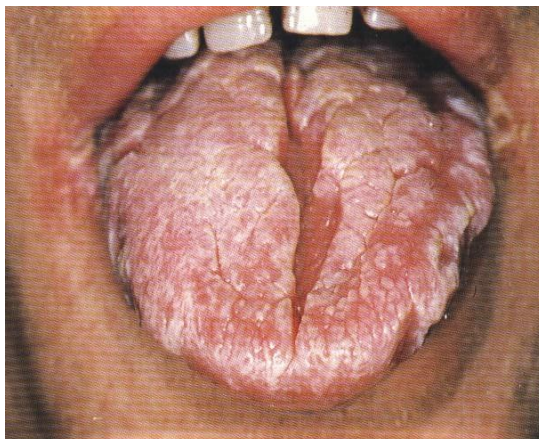
## **CHRONIC MUCOCUTANEOUS CANDIDIASIS: -**

Severe oral candidiasis can also occur as a component of a rare immunological disorder called mucocutaneous candidiasis.

Autosomal recessive disorder.

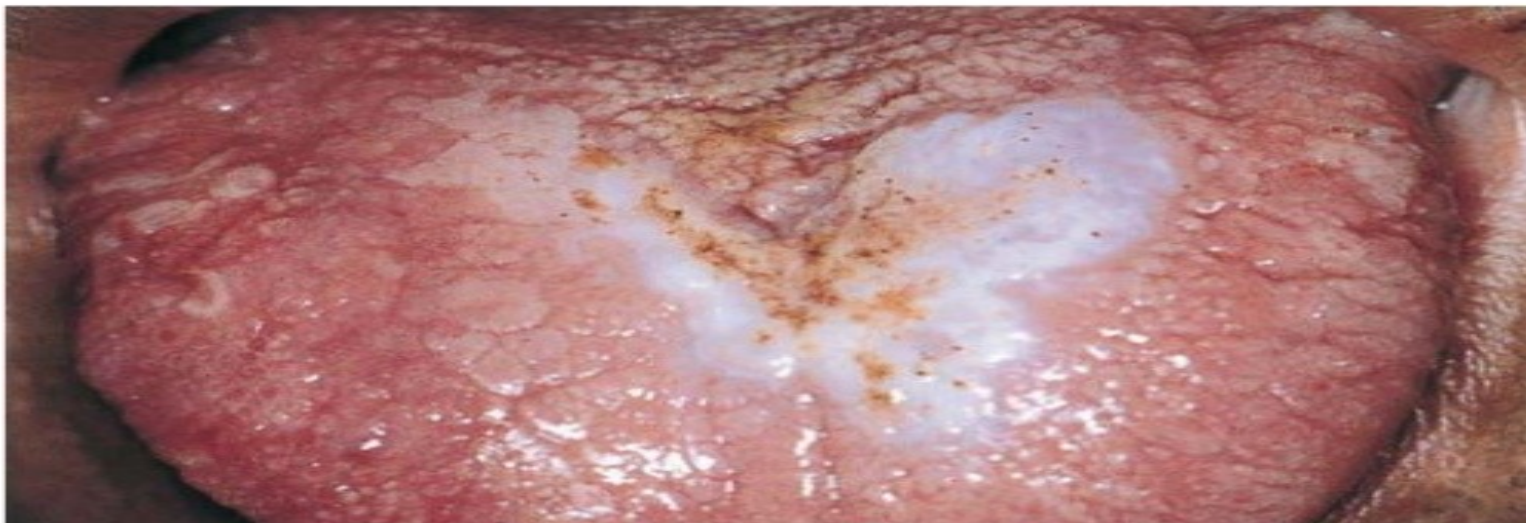
Immune dysfunction becomes evident in early life – patient develops candidiasis of mouth, nails, skin and other mucosae.

Oral lesions appear as thick, white non scrapable patches.





**Fig. 19** Pseudomembranous candidiasis on the palate.



**Fig. 20** Nodular candidiasis.



## Chronic candidiasis in immune deficiency

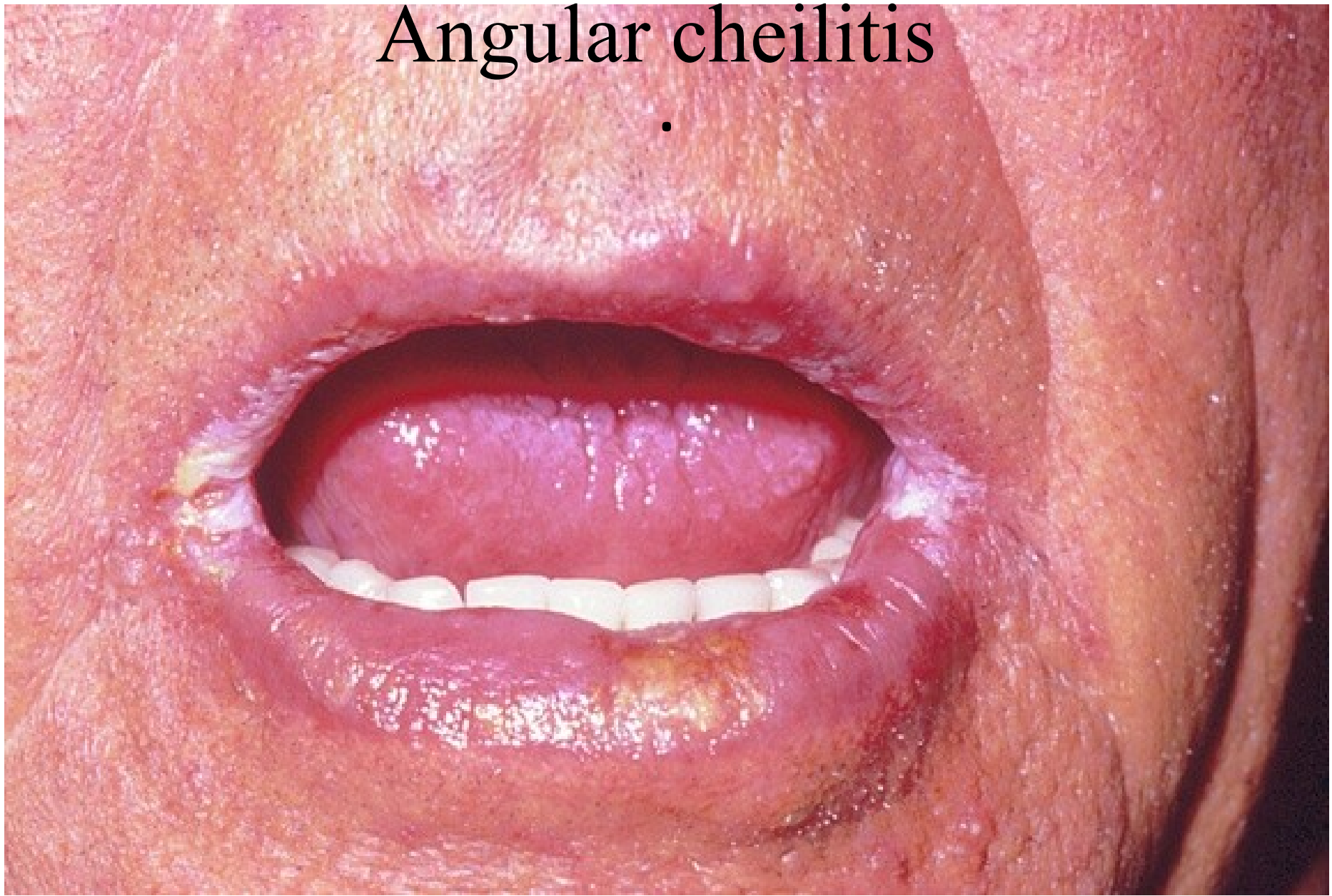


Young infant with chronic superficial  
candidiasis 071



# Angular cheilitis

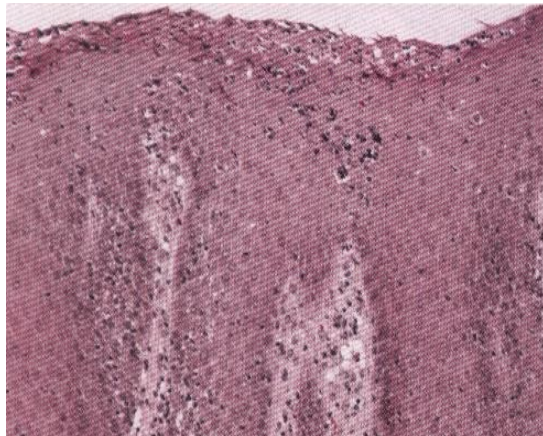
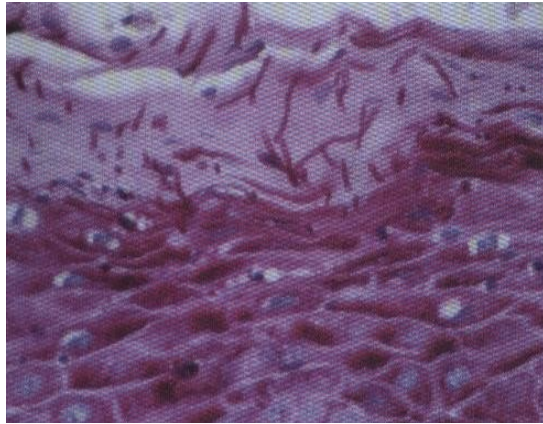
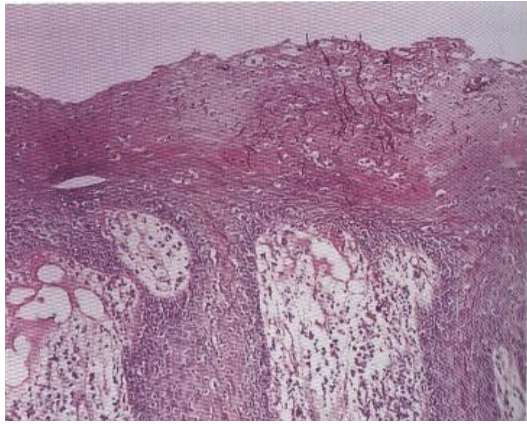
.



060



*Candida granuloma*



## **HISTOLOGICAL FEATURES:** -

Biopsy specimen show hyperparakeratinization, elongation of rete ridges, chronic inflammatory cell infiltration of underlying CT and small microabscesses collection of PMNL's within parakeratin layer.

Candidal hyphae can be seen embedded in parakeratin layer and superficial spinous layer.

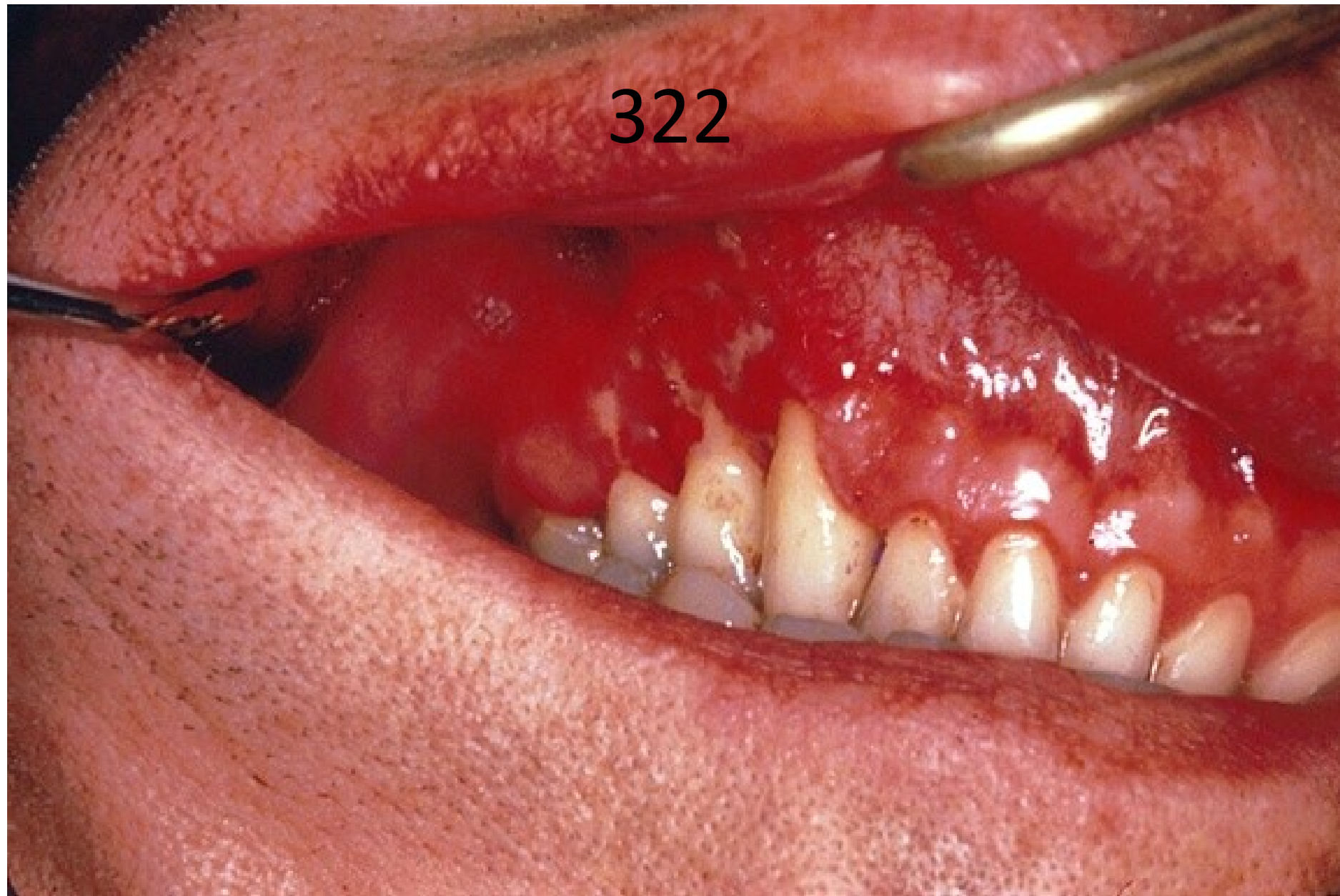
# Histoplasmosis( darling diseases)

- Caused by **Histoplasma capsulatum**, especially from soil enriched with excreta of chicken, starlings, bat.  
Air born spores inhaled, pass into terminal passages of lung and germinate.
- Distribution- world-wide. Most common systemic fungal diases in USA.
- 95% of infections are sub clinical or benign.
- It can be acute, chronic or disseminated form and has a special predilection for reticulo-endothelial system.
- **H/P of lesion shows diffuse infiltrate of macrophages or they organised into granuloma, multinucleated giant cell can seen.**
-

**Oral lesion occur commonly on tongue, palate and buccal mucosa. it presents with solitary painful ulcer of several weeks duration. However some lesions may appear erythematous or white with an irregular borders. The ulcerated lesions have firm, rolled margins , and they may indistinguishable clinically from **malignancy**.**

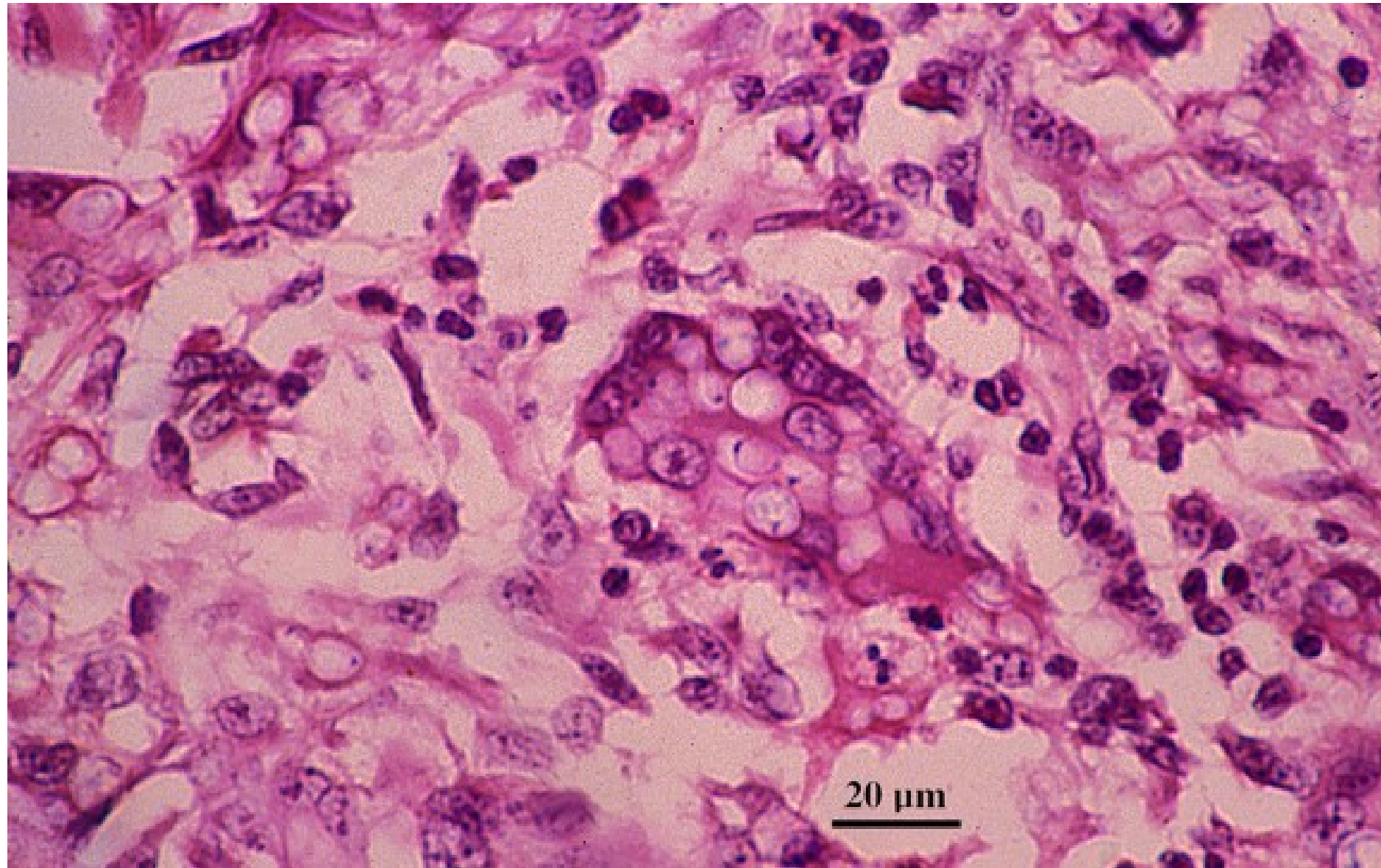
**H/P** of lesion shows diffuse infiltrate of macrophages or commonly collections of macrophages organized into into granuloma, multinucleated giant cell can seen.

322

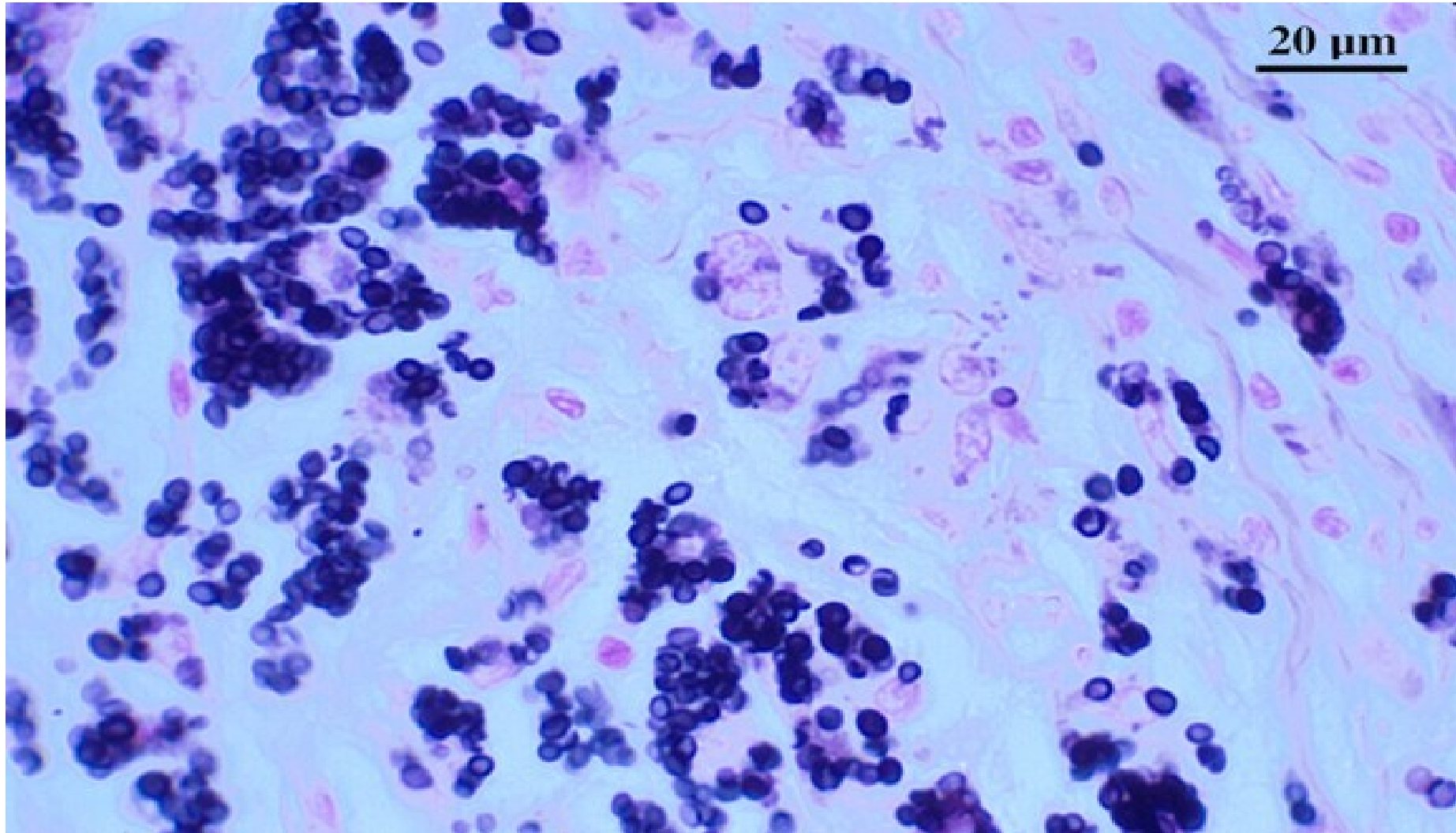




Tissue section stained by Periodic Acid-Schiff (PAS)



Tissue section stained by Grocott's methenamine silver (GMS)  
from a lung biopsy



# **NORTH AMERICAN BLASTOMYCOSIS (GILCHRIST,S DISEASE)**

- Caused by *Blastomyces dermatitidis*, prefer rich, moist soil ,grow as a mold.
- Root of entry by inhalation of spores. Grow in lung alveoli as yeasts.
- Acute form resembles pneumonia. Chronic form is more common and mimic T.B.
- **Oral lesions may result from extra pulmonary dissemination or local inoculation of organism. The lesions may have an irregular erythematous or white intact surface or the may appear as ulcerations with irregular rolled borders with pain and resemble squamous cell carcinoma.**

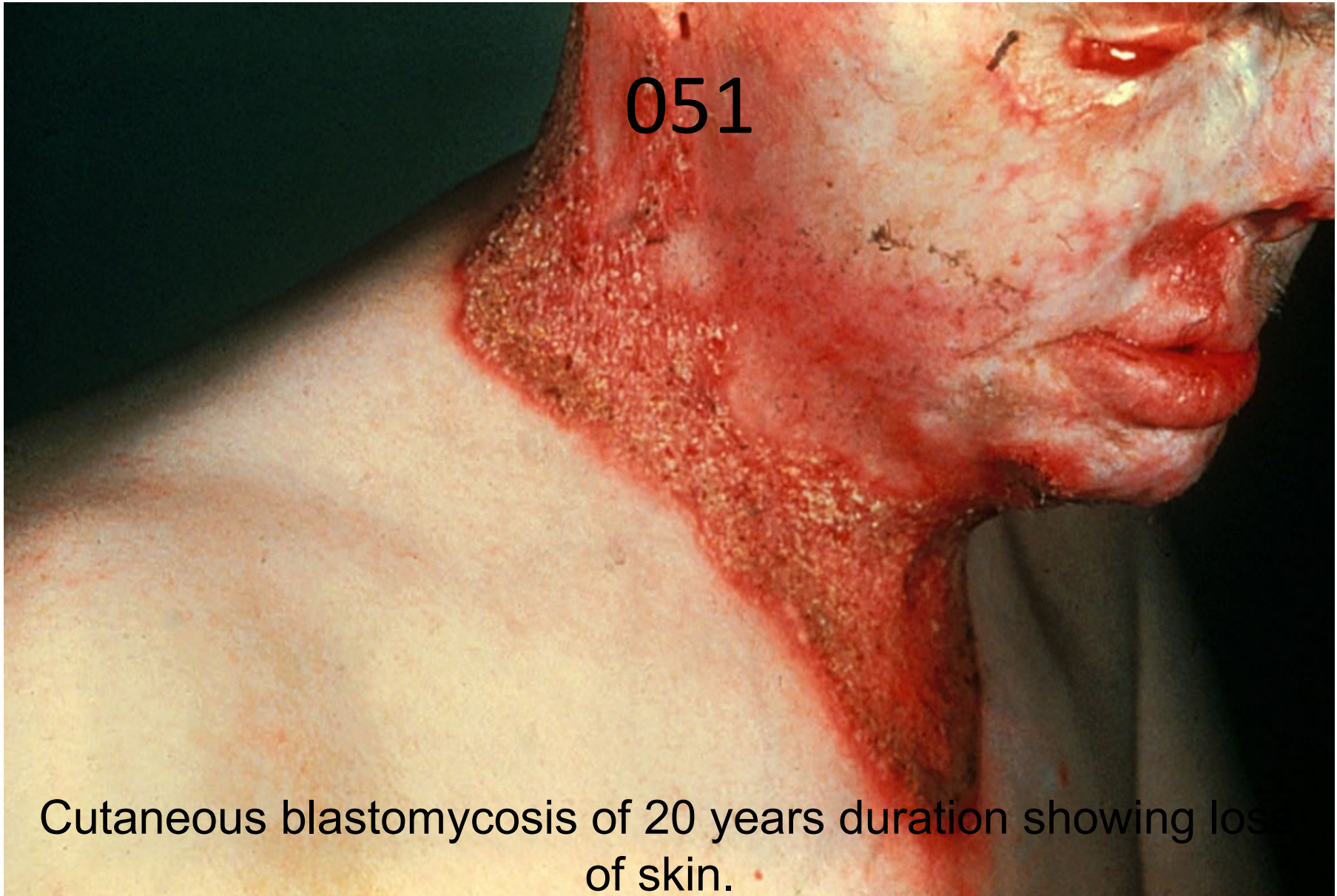
- **H/P** of lesional tissue shows a mixture of acute and granulomatous inflammation surrounding variable numbers of yeasts. These organisms are 8-20 microns in diameter with a doubly refractile cell wall. Pseudoepitheliomatous hyperplasia of overlying mucosa seen due to benign elongation of rete ridges may look like SCC. Underlying inflamed lesional tissue is seen.

050. Ulcerated granuloma due to *B. dermatitidis*

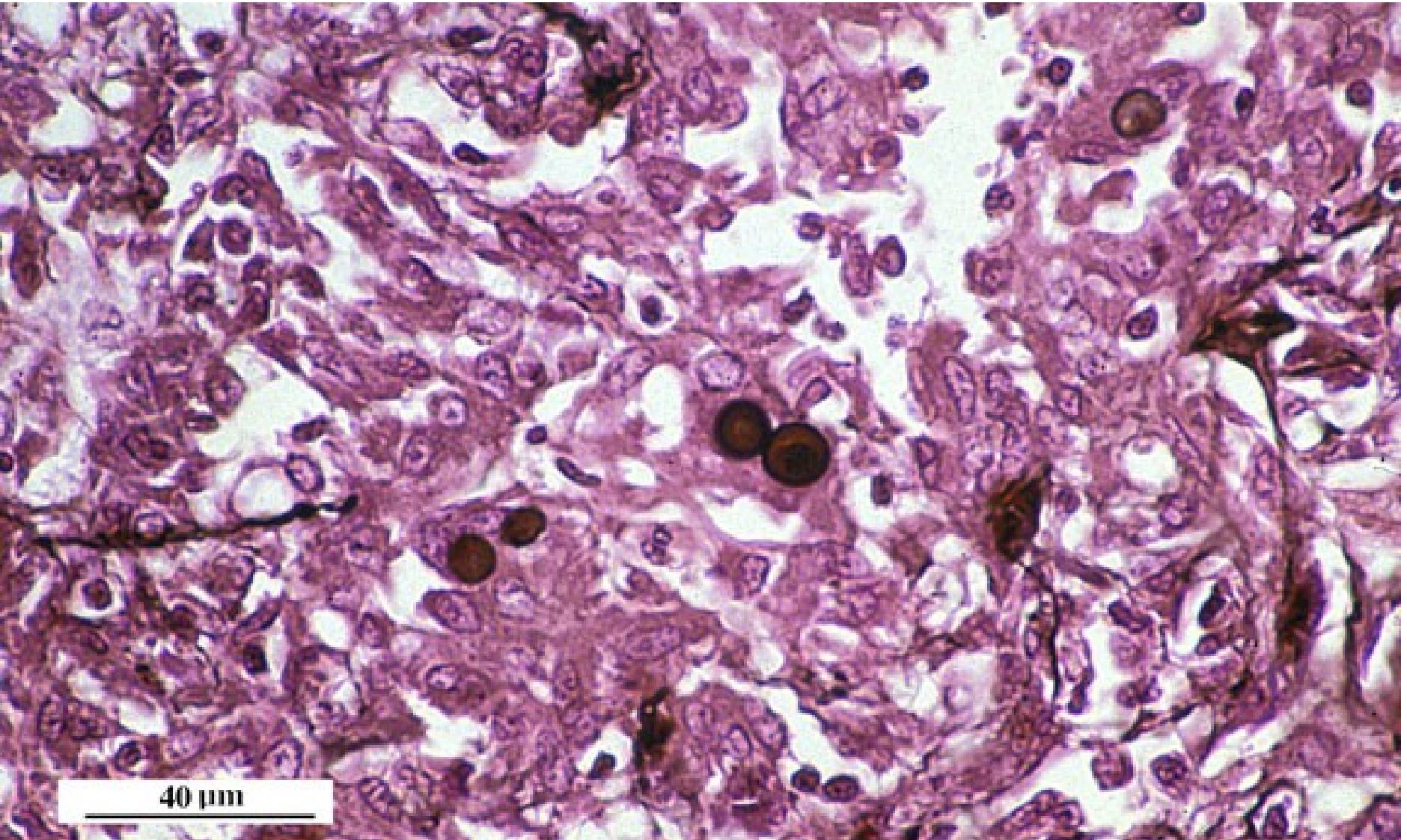


051

Cutaneous blastomycosis of 20 years duration showing loss of skin.

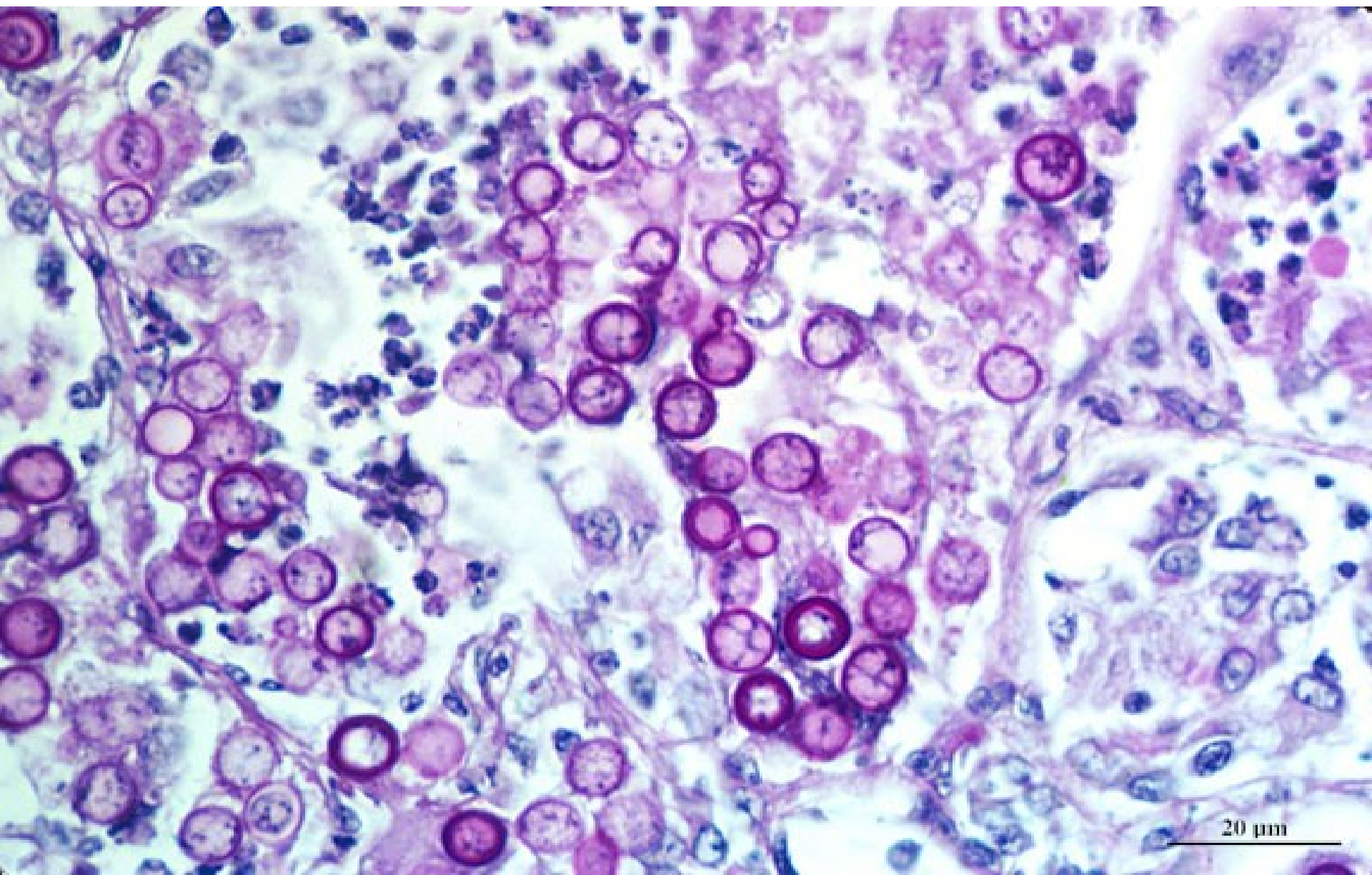


# H & E STAIN ( difficult to observe)



40  $\mu\text{m}$

Stained by Grocott,s  
Methemamine silver method



20  $\mu$ m



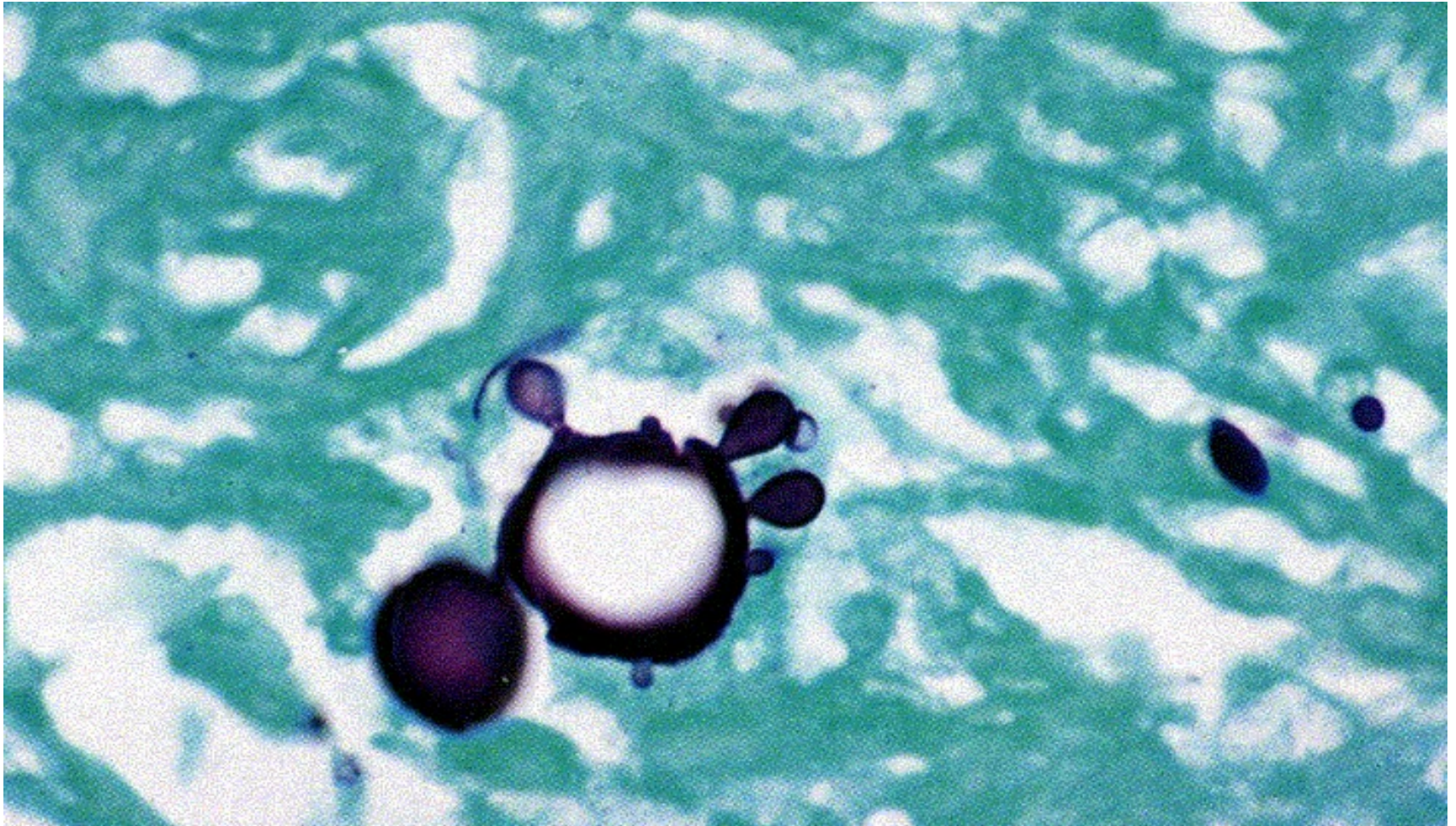
# PARACOCCIDIOIDOMYCOSIS ( south American Blastomycosis.

- caused P. brasiliensis
- Male female ratio is 15: 1 due to beta- estradiol inhibits the transformation of hyphal form to yeast form.
- **oral lesions appear as mulberry like ulcerations commonly affect the alveolar mucosa, gingiva, palate, more than one in number.**
- **H/P** shows pseudoepitheliomatous hyperplasia. Organism often show multiple daughter buds on the parent cell, described as resembling Micket Mouse ears or ships steering wheel..

# paracoccidioidomycosis



Micky mouse ear like

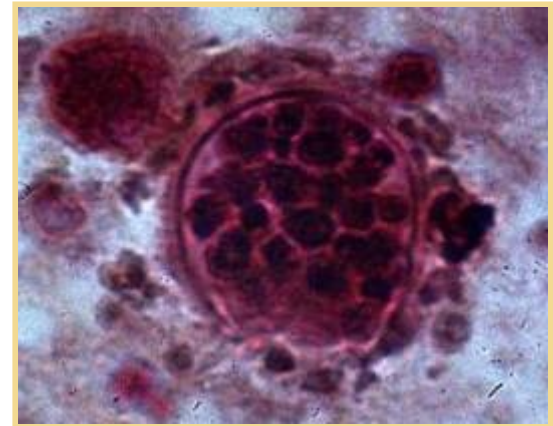


# COCCIDIOIDOMYCOSIS ( SAN JOAQUIN VALLEY FEVER )

- Caused by *C. immitis*.
- Entry by inhalation. May trigger hypersensitivity reaction that causes erythema multiforme like cutaneous reaction called valley fever.
- Cutaneous lesions are abscesses, plaques, granulomatous nodules. Occures in central face near nasolabial fold. **Oral lesion are ulcarated granulomatous nodules.**

# Coccidioides immitis

- Dimorphic fungus
  - Saprophytic phase
  - Parasitic phase
- From soil or dust
  - Arthroconidia become airborne, inhaled
  - Transform into spherule and endospore



# CRYPTOCOCCOSIS.

- Caused by cryptococcus neoformans.
- Distribution world wide as the fungus grow in excreta of pigeon.
- Few cases before AIDS epidemic.
- One of the significant cause of death in AIDS patients and other immunocompromised patients.
- cause meningitis. skin, bone, prostate get affected .
- **Oral lesions are craterlike nonhealing ulcer or friable papillary erythematous plaque.**

# ZYGOMYCOSIS( MUCORMYCOSIS, PHYCOMYCOSIS)

- Caused by the class ZYGOMYCETES, including genera as **Absidia, Mucor, Rhizomucor, Rhizopus**.
- Occures especially in insuline dependent diabetics who have uncontrolled diabetes and are ketoacidotic.
- Classical syndrome in head region is **uncontrolled diabetes, cellulitis, ophththalmoplagia, meningoenceplalitis**.
- Rhinocerebral form is most common form.

- Intraoral swelling in maxillary alveolar process or palate or both due to maxillary sinus involvement. Massive tissue ulceration and necrosis occurs with black appearance.
- Phycomycosis of maxillary antrum may present clinically as a mass in maxilla, resembling carcinoma of antrum.



# MUCORMYCOSIS CLINICAL PRESENTATION

- Five clinical forms of mucormycosis :  
Rhinocerebral ,pulmonary  
,gastrointestinal , primary cutaneous  
and disseminated.
- Rhinocerebral type has the highest  
frequency and mortality.

# Pathophysiology

- Angioinvasion
- Vessel thrombosis
- Tissue necrosis

# RHINOCEREBRAL MUCORMYCOSIS

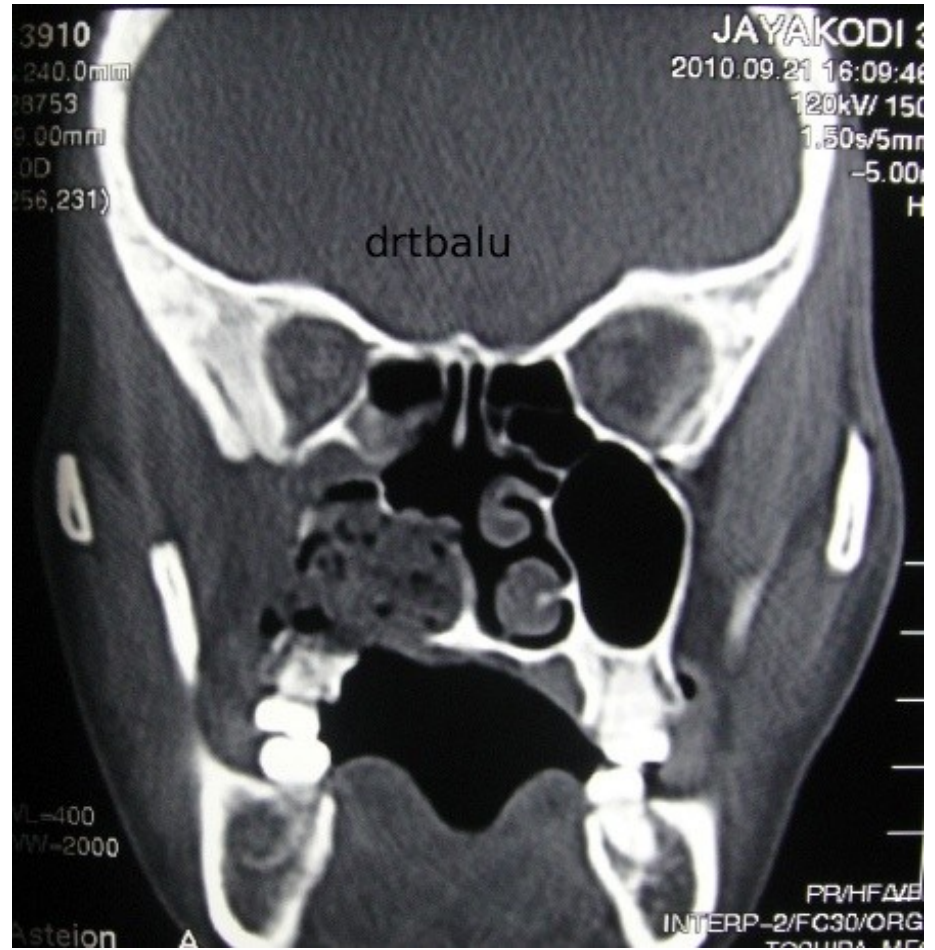
## *Complications*

- Cavernous sinus thrombosis.
- Multiple cranial nerve palsies.
- Visual loss.
- Frontal lobe abscess.
- Carotid artery or jugular vein thrombosis causing hemiparesis.

# RHINOCEREBRAL MUCORMYCOSIS

## *Diagnosis*

- Punch biopsy of the lesion followed by fungal stains and culture.
- Histological examination reveals the characteristic broad, branching hyphae of *Rhizopus* invading the tissue.
- CT or MRI of the head reveal air-fluid level in the sinuses and involvement of deep tissues

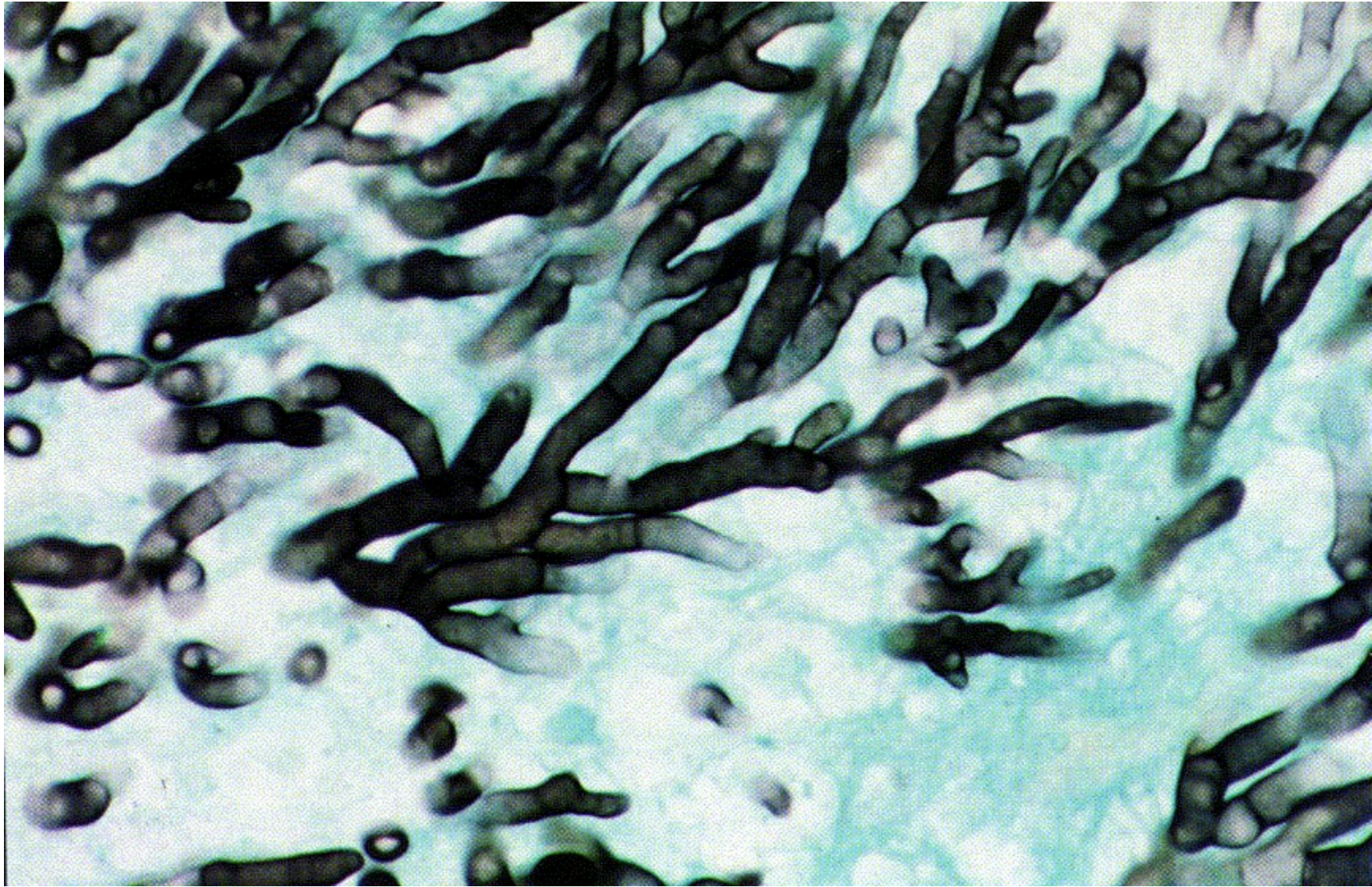


# ASPERGILOSIS

- Disease occurs in two forms- invasive and non invasive.
- Invasive disseminated aspergilosis occurs in immunocompromised patients like AIDS.
- Allergic sinusitis or bronchopneumonia occurs. Some time low grade infection becomes established in the maxillary sinus , resulting in a mass of fungal hyphae called an **aspergiloma**.
- *Aspergillus flavus* and *A.fumigatus* are causative agents.
- **Intraoral lesions – painful gingival ulcerations, mucosa and soft tissue develops diffuse swelling with a gray or violaceous hue and extensive necrosis.**
- **May develop after tooth extraction or endodontic treatment.**

# histopathology

- Differ in invasive and non invasive form.
- The aspergiloma is characterized by tangled mass of hyphae with no evidence of tissue invasion.
- Allergic fungal sinusitis HP exhibits large pools of eosinophilic inspissated mucin with interspersed sheetlike collections of lymphocytes and eosinophils. Few fungal hyphae are identified.





# LABORATORY DIANOSIS



- **1) Direct microscopic examination-**

- 

- **A) wet preparation(mount)-** uses 10%-20% KOH or NaOH as clearing agent.

- Rapidly evaluate specimens for the presence of fungal organism.

- KOH lyses the background of epithelial cells , allowing more resistant yeasts and hyphae to be visualized.

- disadvantage-. No permanent record, difficult to identify, inability to assess epithelial cell populations with respect to other conditions like- dysplasia, pemphigus .

- Wet mount in water also done.( methylene blue is used for staining.

-

- B) calcofluor white stain -shows fungal element in exudate under fluorescent microscope.
- C) Nigrosin or india ink
- D) write stain or gimsea stain

- **2) culture-** grows slow. **Sabouraud's dextrose agar, potato dextrose agar, blood agar, corn meal agar, Rice-grain agar, Littman Oxfall agar.**
- Identification of fungus-
- A) macroscopic examination- study of mycotic colony, myceleum, pigment produced.
- B) microscopic- observe size, shape, septation, colour of spores.
- Yeast form is identified by morphology and biochemical tests. e.g. **germ tube test.**
- Filamentous fungus is identified by immunological method called **exoantigen test-** antigen extracted are immunodiffused against known antisera.

- 3) **histological stain-**
- A) periodic acid schiff
- B) grocott's gomori methenamine silver method.
- C) calcofluor white
- D) fluorescent antibody stain- for rapid diagnosis of fungal cell walls.

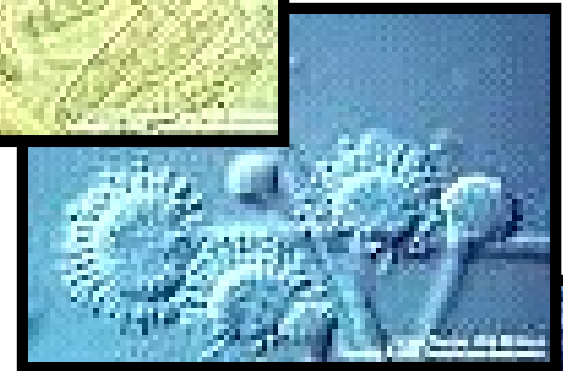
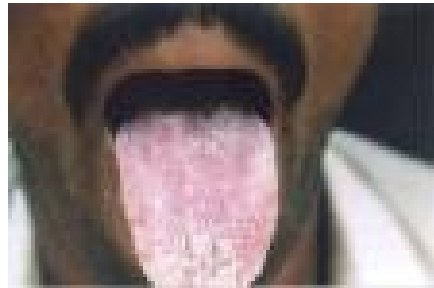
#### 4) **DNA probe test-**

identifys colonies growing in culture at a earlier stages of growth.

Available for- coccidioides, histoplasmosis, blastomycosis, cryptococcosis.

- 5) **immunologic-** for detection of antigen or antibody.  
Compliment fixation , agglutination, precipitin test.
- Useful only for systemic and opportunistic mycosis.
- Compliment fixation test frequently used for suspected cases of - coccidioidomycosis, blastomycosis, histoplasmosis.
  
- 6) **wood's light-** used to determine the prognosis of diseases. Eg. T. capitis yellowish green in colour.

# Antifungal agents





## Fungal infection is difficult to eradicate from body-

- Fungi are eukaryotic like human ,there are no prokaryotic- specific targets for antibiotics. So fewer classes of antifungal agents are available and they are toxic to human.
- Fungi are slow growing, so they take up antimicrobials at a slow rate and therefore treatment is long term.

# Classification based on structure

- **ANTIBIOTICS**

**Polyene:** Amphotericin, nystatin, hamycin

**Hetrocyclic benzofuran:** griseofulvin

- **ANTIMETABOLITE :** Flucytosine

- **AZOLES**

**Imidazoles:** Ketoconazole, clotrimazole, oxiconazole,

miconazole,

**Triazoles:** Fluconazole, itraconazole, voriconazole,

# Classification based on structure

- **ALLYLAMINES**

- Terbinafine, butenafine

- **ECHINOCANDINS**

- Caspofungin, anidulafungin, micafungin

- **OTHER TOPICAL AGENTS**

- Tolnaftate, Undecylinic acid, benzoic acid

- Iron supplements enhances antifungal action-
- Candida uses iron from RBC and food source leading to less available iron in the body.
- Lactoferrine produced by “good” bacteria in gut is inhibited by growth of candida.
- Antifungal drugs like fluconazole inhibit candida, bacteria can grow and produce lactoferrine, absorption of iron occurs from gut, less supply of iron for fungus.

**THE**

**END**