LESSON ASSIGNMENT

LESSON 4
Yeast of Medical Importance.

LESSON ASSIGNMENT
Paragraphs 4-1 through 4-10.

LESSON OBJECTIVES
Upon completion of this lesson, you should be able to

4-1. Select the statement that correctly describes a characteristic of Candida organisms.

4-2. Select the statement that correctly describes a characteristic of Cryptococcus neoformans.

4-3. Select the statement that correctly describes a characteristic of Geotrichum candidum.

4-4. Select the statement that correctly describes a characteristic of genus Torulopsis.

4-5. Select the statement that correctly describes a characteristic of Saccharomyces cerevisiae.

SUGGESTION
After reading and studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 4
YEASTS OF MEDICAL IMPORTANCE

4-1. INTRODUCTION

a. Yeasts are unicellular budding fungi that reproduce by sexual or asexual means. The clinically significant genera of yeasts for man include Candida, Cryptococcus, Saccharomyces, Torulopsis, and Trichosporon. Species of the genus Geotrichum, which are true molds, were once classified under the genus Trichosporon and are still identified with procedures commonly used for yeasts.

b. The incidence of infections caused by yeasts has markedly increased due to therapeutic measures reducing the natural immunity of the host. Burn victims, cancer patients, and individuals receiving antibiotics are representatives of this high-risk group. Yeasts often colonize humans as normal flora but can cause complications and disease. In the past, it was necessary to identify only a few species of yeasts, but repeated isolation of a specific yeast, combined with clinical information, can influence the physician in patient management decisions. Characteristics of yeasts commonly isolated in the clinical laboratory are discussed in the following paragraphs.

4-2. CANDIDIASIS

a. Candidiasis is a disease process usually caused by Candida albicans. In a compromised host, any species within the genus can be pathogenic given the right conditions. Candida spp. often invades moist areas of the skin including the groin, scrotum, fold of the buttocks, under the breast, in the umbilicus, and in interdigital spaces. Characteristic lesions have a red "scalded skin" appearance and a scalloped border. Satellite pustular lesions surround the primary lesion. Dry, scaly lesions may also occur. On direct examination, budding blastoconidia and pseudohyphae are seen. If left untreated, Candida spp. spread easily to other areas of the body. Underlying disease (diabetes, chronic alcoholism, and so forth) or environmental factors that lead to increased moisture (tight clothing in hot climates, continual wear of a wet bathing suit, continual immersion of hands in water) contribute to the disease process.

b. Candida diaper rash is initiated by the colonization of Candida albicans in the diaper-covered area of infants. An allergic reaction precedes invasion of the epidermis. Spreading to other areas of the body is quite common, especially the eyes and mouth. Candida diaper rash is common when poor hygiene is practiced. Constant exposure to unclean, wet diapers should be avoided. When diaper rash occurs, care should be taken to keep the infected area dry.
c. Mucocutaneous candidiasis is almost entirely caused by Candida albicans. However, other species of Candida may be involved in seriously compromised patients. The disease thrush is caused by colonization of Candida in the mouth. It is characterized by white to gray membranous patches, resembling cottage cheese, which involve the tongue and mucomembranes of the oropharynx. It is often found in newborn infants who are infected by strains of Candida albicans from the mother's vagina. This causes a primary oral infection in the newborn before competing flora are established. In older children and adults, poor nutrition, diabetes, and other underlying disease may influence the disease process. Perleche, a Candida infection of the corners of the mouth, is closely associated with thrush.

d. Vaginal candidiasis is quite common. It is characterized by a yellow, milky, or cheesy discharge. The mucous membrane of the vagina may have a mild redness or inflammation with pustules, ulcers, and severe itching. The incidence of Candida vaginitis increases with pregnancy, in diabetes, and prolonged antibiotic therapy. Environmental factors such as wearing a wet swimming suit for a prolonged length of time, tight-fitting pants, and nylon type underwear that does not allow adequate air circulation can also increase the incidence of vaginal candidiasis.

4-3. CANDIDA ALBICANS

Colonies grow aerobically at 25° C to 30° C with some growth visible as early as 24 to 36 hours. Colonies are usually stark white, but may become cream colored or tan with age. They are glabrous, creamy, or membranous, and may have a fringe of submerged hyphae. Microscopic examination shows the presence of globose to ovoid blastoconidia and well developed pseudohyphae. Production of germ tubes and spherical chlamydomes on starvation media is a useful diagnostic characteristic (figure 4-1).

![Figure 4-1. Microscopic morphology of Candida albicans.](image)
4-4. **CANDIDA TROPICALIS**

Colonies of *Candida tropicalis* may be observed within 24 to 72 hours after inoculation. The colonies are white with an occasional blue-green center. The texture is creamy with a marked feathery periphery. Microscopic morphology includes chaining, ovoid blastoconidia alongside long, branching pseudohyphae. Although not commonly seen, "tear drop" shaped chlamydomspores may appear upon prolonged incubation.

4-5. **DIFFERENTIATION OF CANDIDA SPECIES**

a. Tests, to determine the ability of a yeast species to use a carbohydrate as the sole source of carbon in a chemically defined medium, have long been a mainstay of yeast taxonomists and have become an essential step in yeast identification in the clinical mycology laboratory. Most commercial products now available for identifying yeasts rely heavily on carbohydrate assimilation tests. Carbohydrate fermentation tests are also useful tests for yeast identification. However, these tests are more variable and less dependable than carbohydrate assimilation tests. The only reliable evidence for carbohydrate fermentation is the production of gas.

b. Characteristic microscopic morphologies of other *Candida* species that may be isolated in the clinical laboratory include:

1. *Candida guilliermondii*. Rudimentary or well-developed pseudohyphae may be seen. When well developed, the pseudohyphae are slender, often curved and appear as ovoid, or chains of elongated blastoconidia.

2. *Candida krusei*. Pseudohyphae consisting of long cells with tree-like branching are often seen with chains of blastoconidia arising at points of branching. Curved pseudohyphae, with scarce blastoconidia, are seen in some strains.


5. *Candida pseudotropicalis*. Pseudohyphae typically abundant and branched. Chains of blastoconidia are also present.

6. *Candida stellatoidea*. Resembles *Candida albicans*. Both *Candida albicans* and *Candida stellatoidea* produce germ tubes, but *Candida albicans* can assimilate sucrose whereas *Candida stellatoidea* does not.
4-6. **GEOTRICHUM CANDIDUM**

a. *Geotrichum candidum* is most frequently isolated from clinical specimens of the upper respiratory tract. It is found in oral infections similar to thrush, in purulent lesions associated with bronchial infections and in pulmonary lesions with upper respiratory tract congestion.

b. Colonies appear within 24 to 72 hours after inoculation. *Geotrichum* is a filamentous fungus whose initial growth may be glabrous, and creamy to pasty, but becomes velvety or fuzzy with aging and repeated subculture. *Geotrichum* produces true hyphae and arthroconidia but neither pseudohyphae nor blastoconidia, thus differing morphologically from the yeast genus, *Trichosporon*. Arthroconidia are seen in rectangular, consecutive chains. Germ tubes may form on a corner of germinating arthroconidia (figure 4-2).

![Figure 4-2. Microscopic morphology of Geotrichum candidum.](image)

4-7. **CRYPTOCOCCUS**

a. Of the eight recognized species of *Cryptococcus*, the only true pathogen is *Cryptococcus neoformans*. Infections caused by *C. neoformans* are exogenous; the yeast lives naturally in soil contaminated with bird droppings, notably from pigeons and other seed-eating birds. Meningitis is the most frequently recognized type of cryptococcal infection, followed in frequency by localized abscesses or granulomas in lungs, brain, lymph nodes, skin, or bones (figure 4-3). Diffuse pulmonary infection is perhaps the most common type of cryptococcal infection, although it is often asymptomatic and unrecognized. The respiratory tract is believed to be the portal of entry for most, if not all cryptococcal infections.

![Figure 4-3. Encapsulated cells of Cryptococcus neoformans in India ink.](image)
b. Cryptococcus colonies are often mucoid, becoming dull and drier with age. Colonies appear within 24 to 72 hours and are pale buff, becoming tan or brown with age. The genus does not ordinarily form mycelium. Globose dark-walled blastoconidia are seen.

c. C. neoformans can be differentiated from other Cryptococcus spp. by:

(1) Its ability to grow at 37º C (although four other species also grow at 37º C and two are variable).

(2) The production of brown colonies on birdseed agar.

(3) A characteristic assimilation pattern.

(4) Its pathogenicity for experimental animals.

d. Serologic latex agglutination tests may be useful in screening for cryptococcus antigen in CSF, serum, and urine specimens.

4-8. RHODOTORULA

a. Rhodotorula colonies resemble cryptococcus colonies in rate of growth and colony topography. Their cell sizes and shapes are also similar. Its nonpathogenicity, serotype, and conspicuous carotenoid pigment distinguish Rhodotorula as a distinct genus. Rhodotorula is a normal colonizer of moist skin and may be an opportunistic pathogen.

b. Growth occurs within 24 to 72 hours as orange to red colonies with a butyrous texture. Microscopic morphology shows globose to ovoid blastoconidia with no pseudohyphae or hyphae.

4-9. TORULOPSIS

a. Torulopsosis is a disease process caused by the opportunistic organism Torulopsis glabrata. It is part of the normal flora of the mouth, nose, gastrointestinal tract and vagina. Recovery from these sites in an uncompromised host is routinely ignored. Torulopsis glabrata causes disease mostly in hospitalized patients who already have an existing serious disease. The factors that increase colonization and facilitate tissue invasion are similar to those for Candida albicans. The usual portals of entry for the compromised patient are intravenous or intraurethral catheters.
b. Patients with torulopsosis experience a sudden onset of fever that may be accompanied by hypotension. Although serious complications may arise, infections are rarely fatal. The etiological agent is rarely recovered from tissue. The prognosis depends upon ability to identify and eliminate the portal of entry, and the presence or absence of underlying disease. Sepsis caused by *Torulopsis glabrata* is usually seen in patients receiving an increased amount of nutrients by intravenous feeding (hyperalimentation). Prompt removal of the contaminated catheter usually cures the sepsis without any further treatment. A new catheter can be inserted at a different site without detriment to the patient. *Torulopsis glabrata* infection of the urinary tract is commonly found in patients with diabetes mellitus, urinary tract obstruction, and following the use of instrumentation. *Torulopsis glabrata* can cause shallow ulceration in the esophagus or gastrointestinal tract; especially in patients with a hematological malignancy. It is unclear if infection at these sites leads to dissemination.

c. Torulopsis is a common isolate from urine and other specimens. It is considered a symbiont of humans, but has been documented as causing pyelo/nephritis, pneumonia, septicemia, and meningitis in immunocompromised patients.

d. Growth occurs within 24 to 48 hours as white to yellow colonies with a butyrous texture. Microscopic morphology includes small, ovoid blasto/conidia, with no hyphae, pseudohyphae, or capsule observed.

4-10. SACCHAROMYCES

a. *Saccharomyces cerevisiae* is responsible for occasional cases of thrush, vulvovaginitis and urinary tract infections. It is an ascosporogenous yeast. The ascospores may be demonstrated by use of Henrici's ascospore stain to differentiate them from vacuoles.

b. Colonial growth is evident in 24 to 72 hours. Colonies resemble *Candida* in color and texture. Microscopically, the cells appear oval to spherical, and may exist as either haploids or diploids. Cells may form short chains and elongate as rudimentary pseudohyphae. Ascospores, one to four in number, are in either tetrahedral or linear arrangement, and are gram-negative. Vegetative cells, on the other hand, will stain gram-positive.

Continue with Exercises

Return to Table of Contents
EXERCISES, LESSON 4

INSTRUCTIONS: Answer the following exercises by marking the lettered responses that best answers the exercise, by completing the incomplete statement, or by writing the answer in the space provided.

After you have completed all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Which of the following would be considered at high risk of yeast infections?
   a. Newborns.
   b. Burn victims.
   c. Lab personnel.
   d. Hospital patients.

2. A diagnostic characteristic of Candida albicans is the production of:
   a. Chlamydospores on starvation media.
   b. Cream colored colonies.
   c. Pseudohyphae.
   d. Chains of blastoconidia.

3. Procedures used to differentiate Candida species include:
   a. Microscopic morphology.
   b. Carbohydrate assimilation tests.
   c. Carbohydrate fermentation tests.
   d. All of the above.
4. An organism with microscopic morphology resembling *Candida albicans* is:
   a. *Candida krusei*.
   b. *Candida stellatoidea*.
   c. Blastoconidium.
   d. *Candida parapsilosis*.

5. What are the characteristics asexual cell produced by *Geotrichum candidum*?
   a. Chlamydospore.
   b. Pseudohyphae.
   c. Blastoconidium.
   d. Arthroconidium.

6. Infections caused by *Cryptococcs neoformans* are most often located in the __________________________ and the __________________________.

7. Differentiation of *Cryptococcus neoformans* from nonpathogenic members of the species can readily be done by observation of colonial morphology.
   a. True.
   b. False.

8. Which of the following organisms is identified by use of Henrici’s ascospore stain?
   a. *Saccharomyces cerevisiae*.
   b. *Cryptococcus neoformans*.
   c. *Geotrichum candidum*.
   d. *Candida albicans*. 
9. Which of the following is characteristic of Rhodotorula?
   a. Considered a pathogen.
   b. Carotenoid colonies.
   c. Submerged hyphae.
   d. Growth in body fluids.

10. An immunocompromised person may display pyelonephritis caused by:
   a. Trichosporon.
   b. Any nonpathogen.
   c. Torulopsis.
   d. Cryptococcus.

11. Candida infections are most likely to occur in ______________ areas of the skin.

12. Candida albicans is the causative agent for:
   a. Thrush.
   b. Diaper rash.
   c. Vaginitis.
   d. All of the above.
13. The symptoms of infections with *Torulopsis glabrata* include:

a. Headache.

b. Malaise.

c. Hypertension.

d. Fever.

*Check Your Answers on Next Page*
SOLUTIONS TO EXERCISES, LESSON 4

1. b (para 4-1b)
2. a (para 4-3)
3. d (paras 4-5a, b)
4. b (para 4-5b)
5. d (para 4-6b)
6. Meninges, lungs. (para 4-7a)
7. b (para 4-7c)
8. a (para 4-10a)
9. b (para 4-8a)
10. c (para 4-9c)
11. moist. (para 4-2a)
12. d (paras 4-2b, c, d)
13. d (para 4-9b)

Return to Table of Contents