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Management of oral infections: Part 2

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Management of oral infections: Part 2

Abstract

This is part two of a two-part course on managing oral infections. It includes clinical and diagnostic features of bacterial, viral, and fungal infections. Clinical recommendations and current scientific literature and management strategies are reviewed. Scientifically supported alternative therapies are discussed where applicable. The reader should refer to current pharmacology and dosing information prior to prescribing any antifungal therapy.

Educational objectives

At the conclusion of this educational activity, participants will be able to:

1. Identify clinical features associated with different bacterial, viral, and fungal infections.
2. Describe the various treatment strategies for acute viral and fungal infections.
3. Implement appropriate medication management of bacterial, viral, and fungal infections.

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Oral bacterial infections

DENTAL CARIES AND PERIODONTAL DISEASE

The human mouth harbors a diverse microbiome including bacteria, viruses, fungi, and protozoa.[1] The oral cavity is home to a wide variety of bacteria, with more than 700 nonpathogenic and pathogenic species identified, most of which are beneficial and nonpathologic.[2,3] An oral bacterial infection initiates in the mucosa with loss of epithelial integrity permitting inoculation of the underlying tissue by aerobic or anaerobic bacteria with subsequent localized spread and, in some cases, systemic spread. Patients who are immunocompromised or have systemic health issues have greater risk of infections than those who are in general good health with good immune systems.[4] Dental caries, the most common oral disease, is caused by *Streptococcus mutans*, a common intraoral bacterium associated with oral biofilm.[5,6]

Periodontal disease, another common oral condition, is associated with gingival inflammation that progresses to cause subsequent bone loss. This is caused by a variety of bacteria including *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Aggregatibacter actinomycetemcomitans,* among other bacterial species.[7-9] The management of dental caries and periodontal disease is the primary focus of dental practice by both dentists and hygienists, and treatment centers around those two common clinical occurrences. The rationale for treating caries and periodontal disease is underscored by accumulating science suggesting that bacteria in the oral biofilm have been associated with systemic disease.[10] Therefore, patients need to be educated that untreated dental and periodontal disease could increase their risk of developing cardiovascular,[11,12] pulmonary,[13] kidney,[14] and gastrointestinal diseases,[15] as well as Alzheimer's disease,[16] atherosclerosis,[17,18] and complications with diabetes management.[19]

SEXUALLY TRANSMITTED DISEASES

Alterations in the oral mucosa may also be caused by bacteria associated with sexually transmitted diseases and other opportunistic organisms leading to infections. Syphilis and gonorrhea are two sexually transmitted diseases that may have oral initiation and lead to infections that may be first identified orally, either before or after systemic spread. The oral presentation of either syphilis or gonorrhea presents as ulcerations that may be mistaken for other conditions rather than a sexually transmitted disease. Typically, they present as multiple ulcerations and may be found on the tongue, palate, lips, or mucosa (figures 1-5). When suspected, referral to a physician or specialist is recommended as presence of the organisms outside the oral cavity requires systemic treatment.

FIGURE 1: Syphilitic lesions on the tongue (arrows)

FIGURE 2: Syphilitic lesions on the palatal tissue

FIGURE 3: Ulcerations on the palate and lips caused by gonorrhea

ACUTE NECROTIZING ULCERATIVE GINGIVITIS

Another bacterial disease that may present in the dental practice is acute necrotizing ulcerative gingivitis (ANUG). ANUG is a rare but painful superinfection of the gingiva involving aphthous ulceration. This condition affects less than 1% of the population.[20] Patients affected with it may present with fever, malaise, lymphadenopathy, and bad breath, usually with the complaint of severe pain in the gums. The severe form usually affects only people with an impaired immune system. This is commonly observed in patients with human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) or in patients on immunosuppressive drugs. ANUG is not contagious. It begins abruptly with painful, bleeding gums, excessive saliva production, and sometimes extremely foul-smelling breath. The clinical presentation is missing papilla with erythema and ulceration and necrosis of the interproximal gingival tissue (figure 6). The gingiva bleeds easily, and talking, eating, or swallowing causes pain. Often, the lymph nodes under the jaw swell, and a mild fever develops. Spirochetes and *Prevotella intermedia* are present and, in combination with psychological stress, debilitation, immunosuppression, smoking, poor oral hygiene, or poor nutrition, contribute to the development of ANUG. Regardless of the cause, oral mucosal ulcerations may become infected by bacteria normally found intraorally.

FIGURE 4: Syphilitic lesions on the oral mucosa

ANUG treatment should be approached in stages, including treatment of the acute phase, treatment of any preexisting conditions, treatment of any disease sequelae, and transition to a maintenance phase.[21] The acute phase treatment aims to halt tissue destruction and improve patient comfort. This involves gentle

FIGURE 5: Syphilitic lesions on the lips

debridement of superficial gingival biofilm and calculus using ultrasonics along with localized oxygen therapy directed at necrotic lesions. The use of 0.12% chlorhexidine gluconate or chlorine dioxide oral rinse should be considered for home care to reduce the associated bacteria and is recommended twice daily for 30 days.[22] Systemic antibiotics are considered in the acute phase in patients demonstrating poor response to debridement or those with symptoms of systemic involvement, including fever, malaise, and vomiting. Metronidazole (250 mg tid) is the most common first drug choice due to its activity against anaerobes. Penicillin, tetracycline, clindamycin, amoxicillin, and Augmentin have been shown to produce good results and may be considered to supplement metronidazole. Topical antimicrobials are not recommended as they have not demonstrated any benefit over systemic antibiotic use. In immunocompromised patients, it is recommended that the addition of antifungal agents be prescribed to prevent bacterial overgrowth of microbes not susceptible to the antibiotic being taken. *Aspergillus terreus* is an opportunistic fungus associated with ANUG. This microorganism has become an emerging problem and is associated with a high mortality rate.[23]

FIGURE 6: Typical presentation of ANUG demonstrating "punched-out" papilla with necrotic tissue noted interproximally

As ANUG patients present with pain that makes normal activities such as eating or talking difficult, pain management is part of the treatment. Topical anesthetic gels may be used, but they are difficult for the patient to apply where needed. Analgesic oral rinses such as Orajel Analgesic and Antiseptic Rinse (Church & Dwight) and Chloraseptic spray (Prestige Consumer Healthcare, Inc.) are available over the counter and can be found in any drugstore and most grocery stores. Patients can use these products as needed, especially before meals to allow eating with minimal discomfort during healing. Additionally, ANUG can be treated using low-level laser treatment (LLLT) to control pain and accelerate wound healing.[24] Typically, significant pain relief is reported following a single laser treatment but can be repeated on subsequent days if needed. Following LLLT, patients' quality of life is quickly improved, suggesting that this is an effective treatment for the reduction of pain and healing time. After the acute phase of treatment has been controlled, treatment of any preexisting condition, such as chronic gingivitis, should be initiated.

Oral fungal infections

Fungi and yeasts are commonly found in the oral cavity. In healthy individuals, they do not pose a threat of infection as they are opportunistic in nature, only showing an overgrowth under certain circumstances.[25] Those circumstances can include systemic diseases such as diabetes mellitus,[26] patients on immunosuppressive drugs such as those who have had organ transplants,[27] and HIV/AIDS.[28] There is also a higher incidence of oral fungal infections in the aging population related to their decreased immune response, health issues, and daily medications.[29] Additionally, seniors may have decreased salivary flow (xerostomia), which has been linked to increases in oral fungal overgrowth.[30,31] More than 100 different fungi have been identified, with 15 different species of *candida* that may be present in the human mouth that can cause disease.[32] Of those, *Candida albicans* is the most common oral fungal organism associated with infection.[33,34]

FIGURE 7: Angular cheilitis is an indicator in some patients of a fungal infection localized to the corners of the mouth.

ANGULAR CHEILITIS

Candida albicans infection may present in different areas of the mouth. The first signs of infection may be observed in older patients at the corners of the mouth, with cracking and irritation noted (figure 7). This is termed angular cheilitis and is common in seniors. Typically, this occurs due to licking the corners of the mouth and folding of the skin in the area due to loss of skin elasticity, which creates a moist, dark area that favors yeast growth. Treatment includes recommending that the patient try to avoid licking the area and application of a topical antifungal ointment such as Monostat (available OTC), which is also used for vaginal yeast infections. The ointment should be applied several times daily, especially at bedtime. Continued use after the infection resolves will help prevent a reoccurrence.

Candidiasis/candidosis

A minor yeast infection may also be noted on the dorsum of the tongue in patients of all ages under the right conditions. This presents as a bald, nonpainful spot on the tongue that does not appear inflamed or bleed (figure 8). Candida infection on the tongue can progress in patients with compromised immune systems or on strong antibiotics and presents as a white coated tongue with a "furry" appearance that does not wipe off (figure 9). It often is not painful. The infection may spread to the mucosal

FIGURE 8: A "bald" area on the center of the tongue is an indication of rhomboid glossitis caused by a minor fungal issue on the dorsum of the tongue.

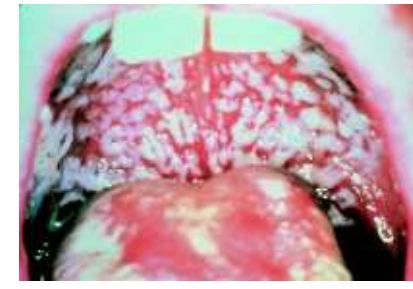

FIGURE 9: Candida albicans infection covering the dorsum of the tongue

FIGURE 10: Acute pseudomembranous candidiasis leading to a fungal superficial mucosal infection

surfaces of the cheeks or soft palate, which are nonkeratinized and more susceptible to fungal infection, typically transferred from the tongue to those surfaces due to contact (figure 10). Superficial mucosal infections are classified as acute pseudomembranous candidiasis, acute erythematous candidiasis, chronic atrophic erythematous candidosis, or chronic hyperplastic candidosis. The appearance clinically has a cottage cheese look on the affected tissue.

Several other species in the genus *Candida* have also been linked to fungal oral infections including *C. glabrata*, *C. krusei*, *C. parapsilosis*, and *C. topicalis*.[35,36] *Candida glabrata*, a common cause of oral thrush, is estimated to be the causative organism in 15%–30% of yeast infections.[37,38] *C. glabrata* infections have a higher mortality rate than most other yeast species and have white cheeselike lesions on the inside of the cheeks, gingiva, and tongue.

The duration of the fungal infection is dependent on a number of variables such as long-term antibiotic or corticosteroid use[39] and immune system suppression.[40] Common candidiasis symptoms include dry mouth, alteration in taste, difficulty swallowing,[41] oral burning,[42] and oral ulcers.[43]

The diagnosis of candidiasis is based on observable lesions and may present in different forms.[44] Pseudomembranous candidiasis presents with white plaques resembling cottage cheese on the mucosa and tongue.[41] When those plaques are wiped, an underlying erythematous epithelium that may bleed is exposed. Erythematous candidiasis is generally found on the palatal tissue, the dorsum of the tongue, and the buccal mucosa due to physical contact between those areas and presents as red irritated areas that may bleed.[45] Chronic hyperplastic candidiasis (candidal leukoplakia) typically occurs on the buccal mucosa and less commonly on the tongue. It presents as raised lesions that may vary from small, palpable, translucent, or whitish lesions to large, dense, opaque plaquelike lesions that are hard to the touch and rough in texture.[41] Patients with removable prosthetics, especially seniors, may be prone to candida infection on the soft tissue where the denture contacts it. This is referred to as chronic erythematous candidiasis (CEC) and is rarely seen in mandibular mucosa in lower denture wearers.[46]

TABLE 1: Adult dosing of antifungal medicaments

Clotrimazole (Lotrimin, Mycelex): A broad-spectrum antifungal agent that alters the fungi cell membrane permeability leading to cell death. Recommended for widespread infection providing the greatest tissue coverage of the antifungal agents available. This medicament is a topical agent (10 mg troche) applied five times per day.[47] *Prescription: Clotrimazole troches 10 mg (Disp: 70 troches; dissolve one troche in mouth five times a day. Do not chew.)*
Miconazole (Oravig): A topical treatment for oropharyngeal candidiasis. Miconazole mucoadhesive tablets are a recent addition to the oral antifungal drugs currently available. A 50 mg buccal tablet is placed and allowed to dissolve in the buccal vestibule once daily for 14 consecutive days.[48] *Prescription: Miconazole 50 mg tablet (Disp: 14 tabs; use once daily; hold one tablet in place against buccal gingiva/mucosa and allow to dissolve.)*
Ketoconazole (Nizoral): Oral ketoconazole can be effective for treatment of severe oral and esophageal candidosis, but patient compliance is often poor because of the drug's taste. The cream form can be used to treat angular stomatitis with ketoconazole cream 2% being applied once daily to the affected and immediate surrounding area.[49] *Prescription: Ketoconazole cream 2% (Disp: 15 gm. tube; apply small dab to affected areas after meals.)*
Fluconazole (Diflucan): Effective in patients with chronic atrophic oral candidiasis, particularly when administered concurrently with an oral antiseptic such as chlorhexidine. Inhibition of the adhesion of candidal organisms to epithelial cells, an essential step in the initial process of candida colonization and the subsequent infection that results. For oral treatment, it is available in tablets or suspension, and the recommended dosage is 200 mg on the first day, followed by 100 mg once daily for a period of two weeks to ensure that the infection does not return.[50] *Prescription: Fluconazole 100 mg tablets (Disp: 15 tablets; two tablets used the first day, then one tablet daily for two weeks.)*
Nystatin (Mycostatin): Used for treatment of esophageal candidiasis and may be used to prevent candidiasis in those who are at high risk. Available as a cream, it is applied liberally to the affected areas twice daily or as indicated until healing is complete and may be used intraorally or applied topically to the skin.[51] *Prescription: Nystatin ointment (Disp: 15 gm. tube, apply thin coat to inner surface of denture and to affected area after each meal.)*

Oral fungal infection management involves use of topical and/or oral antifungal medication (table 1). When the patient with candidiasis is not responding to topical antifungal medicaments or has frequent fungal infection reoccurrences, an underlying systemic problem may be present and the patient should be referred for a medical evaluation to rule out immunosuppression caused by a systemic disease.

DENTURE STOMATITIS

Patients who wear dentures and have a candida infection on the underlying tissue will require disinfection of the denture to prevent reinfection. Soaking the denture after cleaning with a toothbrush in an oral rinse that has demonstrated an ability to kill fungi is important.[52] Oral rinses that have shown effectiveness include hydrogen peroxide, chlorhexidine (Peridex or Perioguard), and chlorine dioxide. Hydrogen peroxide and

chlorhexidine have the potential to affect the soft liner in the denture, shortening the material's lifespan. Chlorine dioxide (Clo-SYS) has not been reported to affect denture materials nor cause the potential staining that is seen with chlorhexidine. An additional consideration is that chlorhexidine is incompatible with nystatin, so the two should not be combined as an intervention.[53]

In patients who have been diagnosed with denture stomatitis or those at risk for an oral fungal infection, topical antifungal agents should be applied to the interior of the denture before insertion and be part of the patient's daily routine to prevent future infections. Treatment of angular cheilitis is best managed by the application of an antifungal ointment (e.g., nystatin) that is mixed with a topical antibiotic as these infections frequently consist of *Staphylococci*, *Streptococci*, as well as *C. albicans* microorganisms. This is particularly true in patients with immunosuppression. Systemic antifungal drugs are recommended to treat cases in which the use of topical therapy is either impractical or ineffective, and they should be prescribed by a medical specialist as drug interactions and adverse reactions involving organ systems are not uncommon.

Oral viral infections

Viral infections are common and can affect the oral cavity as localized or systemic infections. The two most common viral infections that may present in the oral cavity are the human herpesvirus (HHV) and human papillomavirus (HPV). Other localized or systemic viral infections that can be noted in the oral cavity include Coxsackie virus, mumps, measles, rubella, and HIV.

HUMAN HERPESVIRUS (HHV)

HHV infections are common in the oral cavity and may be primary or recurrent infections. Eight types of HHV have been linked with oral disease, each with different disease patterns in their hosts.[54] Herpesviruses are DNA viruses, replicating in the host cell's nucleus, with transmission via infected saliva or droplets in the oral cavity or via the oral-genital contact. When a localized infection occurs, virus penetration of the mucosal epithelium results, with the virus invading the basal cell layer. The virus then inserts its DNA into the host DNA and

FIGURE 11: Herpes simplex lesion presenting on the exterior lip

FIGURE 12: Herpetic lesions on the attached gingiva and a lesion on the inner lip

FIGURE 13: Multiple herpetic lesions on the palatal tissue

virus replication begins. Viral shedding is not indicative of the presence of a clinical lesion and has been detected before, during, and after the appearance of soft-tissue lesions. Therefore, lack of visible lesions does not correlate with a lack of potential infectivity by a patient. Evidence has been reported of herpesviruses as copathogens with the virus associated with HIV.[55] Viruses are documented to be linked to 20% of all human cancers. Kaposi's sarcoma herpesvirus (KSHV/HHV-8) and Epstein-Barr virus (EBV/HHV4) are the only two members of the herpesvirus family known to cause human cancers. EBV has also been linked as a causative agent of Burkitt's lymphoma. Other oncogenic viruses include human papillomavirus (HPV), hepatitis B virus (HBV), and human T-cell lymphotropic virus-1 (HTLV-1).[56,57]

Herpes is categorized into two types: herpes type 1 (HSV-1 or oral herpes) and herpes type 2 (HSV-2 or genital herpes).

FIGURE 14: Herpetic lesion on the lateral surface of the tongue

Most commonly, HSV-1 causes sores in and around the mouth, while HSV-2 is associated with genital viral lesions. Yet, both types of HSV can be identified in the oral or genital areas due to physical transfer during sex or kissing.[58] Herpes viruses establish latent permanent infections in their hosts, although clinical signs of disease may not be detected, persisting as a latent infection. HSV typically appears as a blister or as multiple blisters on or around affected areas. The blisters may break, leaving tender sores.

HSV-1, also referred to as HHV-1, is an infection usually acquired during childhood from ages six months to five years.[59,60] Initial infection is usually asymptomatic, although there may be minor local vesicular lesions. The initial clinical presentation is multiple red painful vesicles with a swollen base occurring on the lips (figure 11), gingiva (figure 12), palate (figure 13), or tongue (figure 14), which can be severely painful as the lesions ulcerate. Onset is abrupt and accompanied by anterior cervical lymphadenopathy, chills, and a high fever (>103°). The lesions typically heal within 10 to 14 days and may recur, with latency being upset by various disturbances such as physical (e.g., injury, ultraviolet light, hormones, menstruation) or psychological (e.g., stress, emotional upset). Recurrence may also be triggered following dental procedures.[61] Subsequent presentations of HSV-1 are known as herpes labialis, or cold sores. Ninety percent of recurrent HSV-1 infections involve the oral mucosa or lips.[62,63] Persistent herpes labialis is indicative of an immunocompromised status, and HIV infection should be tested to rule that out as a copathogen. Statistics indicate 50%–90% of adults globally are seropositive for HSV-1 and HSV-2.[64] Treatment utilizes oral-systemic antivirals, topical antivirals, and in some cases may require use of both modalities (table 2). Topical antiviral creams/ointments can be

TABLE 2: Prescriptions for treatment of oral viral infections with oral-systemic and topical formulations

Treatment of oral herpes[64] for both HSV-1 and HSV-2 is with antiviral oral tablets such as Acyclovir (Zovirax)[67] or Valtrex.[68]

Prescription: Zovirax 200 mg capsules (Disp: 50-60 capsules, Sig: Take one capsule three times a day for 10 days or two capsules three times a day for 10 days.)

Prescription: Valtrex 500 mg capsules (Disp: 10 tabs, Sig: Take one capsule two times a day for 10 days.)

Prescription: Zovirax cream (Disp: 5 gram tube, Sig: Apply to the viral blister five times a day for four days or until blister completely disappears. Refill as needed.)

Prescription: Denavir (Disp: 5 gram tube, Sig: Apply to the viral blister every two hours during waking hours for a period of four days or until the blister completely disappears. Refill as needed.)

prescribed to patients with viral lesions on the exterior area of the lips. These include Zovirax (acyclovir cream, 5%)[65] or Denavir (penciclovir).[66]

HSV-2, also referred to as HHV-2, is the cause of genital herpes. In 2018, there were an estimated 18.6 million prevalent and 572,000 incident genital herpes infections among 18- to 49-year-olds, with women accounting for two-thirds of those prevalent infections.[69] Transmission has been reported to the oral cavity, and herpes lesions intraorally or on the lips may be either HSV-1 or HSV-2.[70] Oral manifestations are clinically similar to that of the HSV-1 infection.

HHV-3, referred to as varicella-zoster virus (VZV), is the causative agent of chicken pox and its secondary reactivation, herpes zoster.[71,72] Its oral manifestation affects the geniculate ganglion, affecting specific branches of the facial nerve. Two clinical manifestations of this involvement of the facial nerve have been reported. When no rash is present over the overlying skin, the condition is referred to as Bell's palsy. When an accompanying rash is present, it is referred to as Ramsay Hunt Syndrome, which often has more severe paralysis at onset. Patients are less likely to recover completely from Ramsay Hunt Syndrome, with possible ringing in the ears (tinnitus) and hearing loss. Intraorally, HHV-3 may include painful blisters on the tongue.

HHV-4, also known as Epstein-Barr virus (EBV), causes infectious mononucleosis, and it is implicated in various diseases, such as African Burkitt's lymphoma, other immunoproliferative disorders, and nasopharyngeal carcinoma.[73] Epstein-Barr virus and human papillomavirus (HPV) have both been implicated in 38% of all virus-related cancers.[74] The oral manifestations are most commonly reported in young adults, demonstrating petechiae of the hard palate, ANUG, lymphadenopathy, pharyngitis, and tonsillitis, with a fever. Those immunocompromised patients may also present with oral hairy leukoplakia.[75]

FIGURE 15: An HPV infection demonstrating dissemination over the mucosa and gingival tissue

FIGURE 16: HPV lesion on the palatal tissue

FIGURE 17: HPV lesions on the lateral tongue

HHV-5, referred to as cytomegalovirus (CMV), is a common herpesvirus that is usually harmless and rarely causes illness.[76] Typically, patients infected with this virus are asymptomatic, and the virus remains alive but dormant. Individuals with a compromised immune system can present with symptoms that may include enlarged lymph nodes, sore throat, muscle aches, fever, fatigue, rash, and malaise. There is also some concern in pregnant women that the virus can be transmitted to the fetus at delivery.[77] Oral manifestations include swelling of the salivary glands and other tissues, and ulcerations of the tongue similar to other viral infections.[78] This virus has a chronic form and is common in patients with deficient immune systems, such as seen in AIDS and transplant patients.

HUMAN PAPILLOMAVIRUS (HPV)

HPV is a nonenveloped double-stranded DNA 50-nm virus that penetrates the mucosal epithelium invading the basal cell layer, where the virus inserts its circular DNA into the host's DNA. Common oral conditions from HPV include recurrent herpes labialis and intraoral recurrent herpes, herpes gingivostomatitis, oral shingles (herpes zoster), infectious mononucleosis, herpangina, erythematous stomatitis, and hand-foot-and-mouth disease. High-risk strains of HPV have been linked to oral squamous cell carcinoma.[79] In addition to the ulcers created by the virus, various subtypes of HPV cause exophytic papules or nodules occurring on the intraoral mucosa, palate, or tongue (figures 15-17). Lesions from this virus may be single or multiple, smooth or corrugated, and white or tan in appearance. Conditions associated with this virus include papilloma (squamous papilloma), verruca vulgaris, condyloma acuminatum, and focal epithelial hyperplasia (Heck's disease). Infection with HIV indirectly contributes to the development of a number of oral problems including papilloma, candidiasis, ANUG, HIV-related periodontal disease, and severe HIV-related aphthous erosions. Dentists or hygienists are most likely to encounter patients with intraoral nodules or papules suggesting verruca vulgaris or condyloma acuminatum and ulcerations suggesting recurrent intraoral

HSV infection. As a result of fever, malaise, or fatigue and severe oral and throat pain, patients will typically seek medical attention before presenting to a dentist. However, significant oral pain may lead the patient to seek emergency dental treatment. HPV has been linked with oral squamous cell carcinoma and, when identified, patients should be referred to a dental specialist with training in management and treatment or an ear-nose-throat specialist (ENT) to confirm and treat the virus and possible carcinoma that may be present.[80]

HUMAN IMMUNODEFICIENCY VIRUS (HIV)

HIV is the etiologic viral agent of acquired immunodeficiency syndrome (AIDS). Patients infected with HIV are immunocompromised and, as such, other infections are often copresent and may be the first indicators of possible HIV infection. Initial oral manifestations may include fungal (candidiasis, histoplasmosis, cryptococcosis), viral (herpes simplex, herpes zoster, CMV, EBV with hairy leukoplakia, HHV-8 with Kaposi's sarcoma, HPV with oral warts), or bacterial (linear gingival erythema, NUP, TB). Recent evidence has found coinfection with HIV and SARS-CoV-2 (COVID-19).[81] Kaposi's sarcoma has been identified only in patients infected with HIV and is a clinical indicator of that virus being present systemically. It presents as a vascular tumor originating from the endothelial and immune cells, with lesions usually appearing on the skin and oral mucosa, but it may also involve lymph nodes and visceral organs. The lesions typically present as multiple painless purplish spots on the face, oral mucosa, and genitalia[82] (figures 18, 19). When identified clinically, patients need to be referred to a specialist for treatment and management of HIV, as well as determination of whether it has progressed to AIDS.

FIGURE 18: Kaposi's sarcoma on the lateral aspect of the ridge on the mucosa

FIGURE 19: Kaposi's sarcoma on the palate

Conclusion

Bacterial, fungal, and viral microorganisms cause infection of the oral mucosa that may be identified in the dental practice either during consequential identification during routine treatment or related to an emergency for oral pain. Management of oral infections centers on patient assurance and education regarding risk, palliative home-care instructions, recommendations regarding over-the-counter medications, and, when appropriate, prescribed antibacterial, antifungal, and antiviral agents. Typically, those lesions caused by bacteria, fungi, or viruses have some pain associated with them, and pain management during healing of the infection needs to be performed. This can be done with either topical medication or use of the laser in the case of viral lesions to give immediate pain reduction and speed healing. Patients with persistent lesions may need to be further assessed medically to rule out underlying systemic pathology.

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QUESTIONS

1. The human mouth harbors more than ___ different species of bacteria, viruses, fungi, and protozoa.
   A. 500
   B. 600
   C. 700
   D. 800

2. Which group of patients has a greater risk of infection than those who are in general good health?
   A. Immunocompromised
   B. Senior citizens
   C. Systemic health issues
   D. All of the above

3. Which is the most common dental disease?
   A. Periodontal disease
   B. Caries
   C. Periapical abscess
   D. Edentulism

4. Periodontal disease is associated with which of these bacteria?
   A. *Tannerella forsythia*
   B. *Streptococcus mutans*
   C. *Bacteroides oralis*
   D. *Staphylococcus aureus*

5. Systemic health is affected by bacteria in:
   A. Dental caries
   B. Periapical abscesses
   C. Oral biofilm
   D. Epithelial mucosa

6. Acute necrotizing ulcerative gingivitis is reported how often in the population?
   A. 1%
   B. 2%
   C. 3%
   D. 4%

7. When ANUG is present, all of the following will be noted except:
   A. Fever
   B. Malaise
   C. Soft-tissue swelling
   D. Lymphadenopathy

8. One of the key clinical presentations of ANUG that helps differentiate it from other oral infections is:
   A. Dark pigmented gingiva
   B. Cottage cheeselike appearance to the soft tissue
   C. Punched-out papilla
   D. Lacelike appearance of the soft tissue

9. Fungal infections are generally found in all of these types of patients except:
   A. Immunocompromised
   B. Organ transplant
   C. Menopausal
   D. Poorly controlled diabetes

10. Which common oral condition has been associated with fungal infections?
    A. Xerostomia
    B. Gingivitis
    C. Bell's palsy
    D. Sialorrhea

11. Often observed in seniors, cracking and irritation at the corners of the mouth describes:
    A. NOMA
    B. Obicularis oris
    C. Angular cheilitis
    D. Granulomatous cheilitis

12. Which yeast is the most common in oral fungal infections?
    A. *Candida glabrata*
    B. *Candida krusei*
    C. *Candida parapsilosis*
    D. *Candida albicans*

13. The duration of the fungal infection is dependent on all of these variables except:
    A. Long-term antibiotic use
    B. Corticosteroid use
    C. Diabetes medication use
    D. Immune suppression medication use

14. Common candidiasis symptoms include all except:
    A. Increased salivation
    B. Alteration in taste
    C. Difficulty swallowing
    D. Oral ulcerations

15. Pseudomembranous candidiasis presents with what clinical appearance?
    A. Erythematous areas on the mucosa and tongue
    B. White plaques on the mucosa and tongue
    C. Nonwipeable areas on the mucosa and tongue
    D. Loss of texture on the surface of the mucosa and tongue

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QUESTIONS

16. Candida infection management involves use of:
    A. Oral antibiotics
    B. Topical and/or oral antifungal medication
    C. Warm salt water rinses
    D. Low-level laser therapy

17. To prevent fungal infection in denture patients, it is recommended to soak the denture in:
    A. Chlorine dioxide
    B. Warm salt water
    C. Chlorhexidine
    D. Hydrogen peroxide

18. Denture stomatitis presents as an asymptomatic, chronic erythema with edema in what percent of denture wearers?
    A. 20%–25%
    B. 35%–40%
    C. 45%–50%
    D. 60%–65%

19. Angular cheilitis is treated by topical application of ___ to the corners of the mouth?
    A. Triple antibiotic ointment
    B. Nystatin ointment
    C. Neomycin ointment
    D. Polymixin ointment

20. Viruses are documented to be linked to what percentage of all human cancers?
    A. 5%
    B. 10%
    C. 20%
    D. 30%

21. How many identified human herpesviruses are there?
    A. 5
    B. 8
    C. 11
    D. 13

22. Epstein-Barr virus has been linked to:
    A. Kaposi's sarcoma
    B. Squamous cell carcinoma
    C. Burkitt's lymphoma
    D. Neurofibromatosis

23. Herpes simplex virus 1 (HSV-1) is typically acquired:
    A. During childhood
    B. During puberty
    C. Through sexual contact
    D. As a result of immunosuppression

24. The initial clinical presentation of HSV-1 is:
    A. White plaque that is not wipeable
    B. Solitary ulceration
    C. Multiple red painful vesicles
    D. Nonpainful red patches

25. What percentage of adults globally are seropositive for HSV-1 and HSV-2?
    A. 5%–15%
    B. 20%–35%
    C. 44%–52%
    D. 50%–90%

26. A patient with herpes zoster must have a history of ___ infection.
    A. Measles
    B. Chicken pox
    C. Smallpox
    D. Mumps

27. Subsequent presentations of HSV-1 involving the oral mucosa or lips account for what percentage of recurrent HSV-1 infections?
    A. 57%
    B. 75%
    C. 83%
    D. 90%

28. Persistent herpes labialis may be indicative of:
    A. An immunocompromised status
    B. Prior chicken pox infection
    C. Long-term antibiotic use
    D. Uncontrolled diabetes

29. Evidence has recently been reported of coinfection between HIV and:
    A. SARS-CoV-2
    B. Syphilis
    C. MERS-CoV
    D. Trichomonas vaginalis

30. Kaposi's sarcoma is a tumor of what type of tissue?
    A. Epithelial
    B. Neural
    C. Vascular
    D. Lymphatic

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ANSWER SHEET

Management of oral infections: Part 2

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1. Identify clinical features associated with different bacterial, viral, and fungal infections.
2. Describe the various treatment strategies for acute viral and fungal infections.
3. Implement appropriate medication management of bacterial, viral, and fungal infections.

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1. Were the individual course objectives met?

   Objective #1: Yes No Objective #2: Yes No Objective #3: Yes No

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2. To what extent were the course objectives accomplished overall?	5	4	3	2	1	0
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5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
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8. Please rate the usefulness and clinical applicability of this course.	5	4	3	2	1	0
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9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

EXAM INSTRUCTIONS
All questions have only one answer. If mailed or faxed, grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a Verification of Participation form. The form will be mailed within two weeks after receipt of an examination.

COURSE EVALUATION AND FEEDBACK
We encourage participant feedback. Complete the evaluation above and e-mail additional feedback to Aileen Southerland (asoutherland@endeavorb2b.com) and Laura Winfield (lwinfield@endeavorb2b.com).

COURSE CREDITS AND COST
All participants scoring 70% or higher on the examination will receive a verification form for three (3) continuing education (CE) credits. Participants are urged to contact their state dental boards for CE requirements. The cost for courses ranges from $20 to $110.

PROVIDER INFORMATION
Endeavor Business Media is an ADA CERP–recognized provider. ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP neither approves nor endorses individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry. Concerns about a CE provider may be directed to the provider or to ADA CERP at ada.org/cerp.

Endeavor Business Media is designated as an approved PACE program provider by the Academy of General Dentistry. The formal continuing dental education programs of this program provider are accepted by the AGD for fellowship, mastership, and membership maintenance credit. Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. The current term of approval extends from 11/1/2019 to 10/31/2022. Provider ID# 320452. AGD code: 730.

Dental Board of California: Provider RP5933. Course registration number CA code: 03-5933-21093. Expires 7/31/2022. "This course meets the Dental Board of California's requirements for three (3) units of continuing education."

Endeavor Business Media is designated as an approved provider by the American Academy of Dental Hygiene Inc. #AADHPNW (January 1 2021 - December 31, 2022). Approval does not imply acceptance by a state or provincial board of dentistry. Licensee should maintain this document in the event of an audit.

RECORD KEEPING
Endeavor Business Media maintains records of your successful completion of any exam for a minimum of six years. Please contact our offices for a copy of your CE credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

CANCELLATION AND REFUND POLICY
Participants who are not 100% satisfied can request a refund by contacting Endeavor Business Media in writing.

IMAGE AUTHENTICITY
The images in this educational activity have not been altered.