



Antiviral Agents, Topical Therapeutic Class Review (TCR)

January 27, 2020

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FDA-APPROVED INDICATIONS

Drug	Manufacturer	Indication(s)
acyclovir cream (Zovirax®) ¹	generic, Valeant	Treatment of recurrent herpes labialis (cold sores) in immunocompetent adults and children 12 years of age and older
acyclovir ointment (Zovirax®) ²	generic, Valeant	Management of initial genital herpes and in limited non-life-threatening mucocutaneous herpes simplex virus infections in immunocompromised adult patients
acyclovir/hydrocortisone (Xerese®) ³	Valeant	Early treatment of recurrent herpes labialis (cold sores) to reduce the likelihood of ulcerative cold sores and to shorten the lesion healing time in adults and children 6 years of age and older
docosanol (Abreva®) ⁴	generic, GlaxoSmithKline	Treatment of cold sores/fever blisters on the face or lips in adults and children 12 years of age and older to shorten healing time and duration of symptoms
penciclovir (Denavir®) ⁵	Mylan	Treatment of recurrent herpes labialis (cold sores) in adults and children 12 years of age and older

OVERVIEW

Herpes labialis is an infection of the lips or perioral area.⁶ The primary infection is usually asymptomatic; however, it can also present itself as herpes simplex virus (HSV) gingivostomatitis (of the mouth and gums). Herpes labialis (fever blisters, cold sores) can be caused by either herpes simplex virus-1 (HSV-1) or herpes simplex virus-2 (HSV-2). While the primary (first episode) infections with HSV-1 or HSV-2 do occur, recurrences are generally the result of HSV-1 infection. Oral recurrences with HSV-2 are very rare.

In the United States (US), about 48% of people aged 14 to 49 years have serologic infection with HSV-1 and 12% are seropositive for HSV-2.⁷ Prevalence of both HSV-1 and HSV-2 is higher among females than males. Roughly 30% of individuals with HSV-1 have clinically apparent outbreaks, while 80% of HSV-2 infections are asymptomatic or unrecognized.^{8,9,10,11} Approximately 80% of oral lesions are caused by HSV-1. HSV-1 was previously reported to cause about 20% of genital lesions; however, that figure is increasing, with recent data suggesting that HSV-1 may account for 78% of genital lesions in college-age students in the US. The first infection of HSV-1 typically occurs in children aged 6 months to 5 years, while HSV-2 most commonly first occurs in adults and adolescent ages 18 to 25 years.

Most people acquire HSV-1 asymptotically. Once a person begins to produce antibodies, the infection becomes latent in the sensory ganglia.¹² Orolabial HSV infection, typically HSV-1, remains latent in the trigeminal ganglia; genital HSV infection, typically HSV-1, remains latent in the sacral ganglia. The viruses become reactivated secondary to certain stimuli including fever, upper respiratory infection, physical or emotional stress, ultraviolet light exposure, and axonal injury. Most recurrent episodes of herpes labialis are preceded by a prodromic phase which may consist of tingling, itching, or redness. These can last for up to 24 hours before lesion development. Recurrent infections tend to be less severe because of existing cellular and humoral immunity from prior exposures. Infection by HSV requires a break in the skin's barrier; intact skin is resistant to the virus. Without treatment, healing is complete in about 10 days.¹³

Most patients with recurrent herpes labialis have < 2 occurrences per year.¹⁴ The rate of recurrence of genital herpes depends on a number of factors including viral type, prior immunity to autologous or

heterologous virus, gender, and immune status of the host.¹⁵ Genital herpes caused by HSV-2 tend to recur more often than cases due to HSV-1.

Antiviral therapy includes both oral and topical preparations. Oral treatments have long been the standard of care for most patients, as supported by clinical trials.^{16,17,18,19} Oral antivirals are commonly used as preventative care, as well. Patients will take a low-dose oral antiviral daily to help prevent an outbreak or initiate treatment when they feel an episode coming on to help prevent a lesion. Suppressive therapy should be considered in patients with recurrent herpes labialis which manifests ≥ 6 times per year.²⁰ The topical preparations are reserved for treatment of an active lesion. Topical preparations should be started as early as possible in the prodrome phase in order for treatment to be most beneficial.

The 2015 Centers for Disease Control and Prevention (CDC) sexually-transmitted disease (STD) recommendations for genital herpes state oral antiviral therapy is preferred over topical antiviral therapy.²¹ Chronic suppressive therapy for patients with frequent recurrences may include oral agents according to the CDC STD guidelines. Topical treatment with antivirals offers minimal clinical benefit, and its use is discouraged.

Topical acyclovir was touted as effective in preventing herpes simplex labialis in 1983, but further trials cast doubt about whether it can significantly alter the course of disease and normal healing.^{22,23} Suppression studies produced promising results, notably clinical trials that demonstrated significant differences favoring acyclovir in terms of healing time.^{24,25} Topical penciclovir later demonstrated that it had similar antiviral properties as acyclovir. Although comparison trials have not been performed, studies showed penciclovir was as efficient in reducing healing time as other topical preparations on the market.²⁶

Docosanol (Abreva) is the only FDA-approved over-the-counter (OTC) medication to treat cold sores/fever blisters. It reduces healing time and duration of symptoms of herpes labialis.

PHARMACOLOGY^{27,28,29,30,31}

Acyclovir is a synthetic purine nucleoside analogue with inhibitory activity against herpes simplex virus types 1 (HSV-1), 2 (HSV-2), and varicella-zoster virus (VZV). This inhibitory activity is highly selective due to its affinity for the enzyme thymidine kinase (TK). This enzyme converts acyclovir into acyclovir monophosphate, a nucleoside analogue which is further converted into diphosphate and then into triphosphate. Acyclovir triphosphate stops replication of herpes viral DNA. This is accomplished in 3 ways: (1) competitive inhibition of viral DNA polymerase; (2) incorporation into and termination of growing viral DNA chains; and (3) inactivation of viral DNA polymerase. This phosphorylation is done more efficiently by HSV; therefore, a greater antiviral activity against HSV exists.

Penciclovir has a similar mechanism of action as acyclovir. It is highly selective for HSV-1 and HSV-2 infected cells which may be attributed to 2 factors. First, viral thymidine kinase phosphorylates penciclovir more rapidly than cellular thymidine kinase. Therefore, the active penciclovir triphosphate is present at a higher concentration in HSV-infected cells than in uninfected cells. Second, the activated drug binds to viral DNA polymerases with a higher affinity than to human DNA polymerases. As a result, penciclovir exhibits negligible cytotoxicity to healthy cells. Penciclovir appears at least as effective as acyclovir as an inhibitor of herpes virus DNA synthesis.

The exact mechanism of action of docosanol is not known. Docosanol is not directly virucidal but it indirectly inhibits viral replication. This inhibition is due to the ability of docosanol to block the fusion of lipid-enveloped viruses (e.g., HSV-1 and HSV-2) with cell membranes. This, in turn, leads to inhibiting cellular entry, nuclear localization, and subsequent viral replication. The development of resistance to docosanol is unlikely since it modulates the host cell to prevent viral entry and does not inhibit the synthesis or replication of the virus.

Hydrocortisone is the primary glucocorticoid secreted by the adrenal cortex. Hydrocortisone can be applied topically in order to suppress the clinical signs of diseases, such as herpes labialis, where inflammation is a prominent feature.

PHARMACOKINETICS^{32,33,34,35}

Systemic absorption of all the topical antiviral agents is low. However, the therapeutic effects of antiviral drugs in treating herpes labialis are evident when the cellular concentration of the drug approaches an optimum level. Oral acyclovir (even in high doses) does not produce the concentration necessary to generate that level of response consistently, despite positive results. Penetration of topical preparations of acyclovir through the stratum corneum has proven difficult.^{36,37} The cream formulation has exhibited greater penetration in herpes labialis compared to the ointment formulation; however, comparative studies have not been performed to compare their efficacy.^{38,39} In contrast to acyclovir, penciclovir has a prolonged half-life (10 to 20 times longer) in HSV-infected cells.⁴⁰

Topical corticosteroids can be absorbed through intact skin and have systemic side effects. Applying topical corticosteroids to abraded or inflamed skin may increase systemic absorption and side effects. Once absorbed through skin, topical corticosteroids act similarly to systemically administered corticosteroids and are metabolized by the liver and excreted by the kidneys. Topical corticosteroids and their metabolites can also be excreted into the bile.

CONTRAINDICATIONS/WARNINGS^{41,42,43,44,45}

Hypersensitivity to these agents and any of their components is considered a contraindication. These agents are for topical use only. They should not be used for ophthalmic, intranasal, intraoral, intravaginal use, or in or near the eyes. Discontinue if sensitization or severe local irritation occurs.

Acyclovir, penciclovir, and docosanol cream should only be used on herpes labialis on the external aspect of the lips and face. Because no data are available, it is not recommended to apply acyclovir or penciclovir cream to mucous membranes. The effects of acyclovir, penciclovir, and docosanol cream have not been established in immunocompromised patients.

There are no data to support the use of acyclovir ointment 5% to prevent transmission of infection to other persons or prevent recurrent infection when applied in the absence of signs and symptoms. It should not be used to prevent recurrence of HSV infection.

DRUG INTERACTIONS^{46,47,48,49,50}

Clinical experience has identified no interactions resulting from systemic or topical administration of other drugs concomitantly with any of these agents. Drug interaction studies have not been performed with acyclovir/hydrocortisone (Xerese).

ADVERSE EFFECTS^{51,52,53,54,55}

Drug	Application Site Irritation	Pruritus	Rash	Headache	Pain	Allergic Reaction
acyclovir cream (Zovirax)	5	< 1	nr	nr	< 1	< 1
acyclovir ointment (Zovirax)	nr	4	nr	nr	30	nr
acyclovir/hydrocortisone (Xerese)	< 1	nr	nr	nr	nr	reported
docosanol (Abreva)	2.9	0.4	0.5	10.4	reported	nr
penciclovir (Denavir)	1.3	0	0.1	5.3	0	0

Adverse effects are reported as a percentage. Adverse effects data are obtained from package inserts and are not meant to be comparative or all inclusive. nr = not reported.

SPECIAL POPULATIONS^{56,57,58,59,60,61}

Pediatrics

Safety and effectiveness of acyclovir (Zovirax) 5% ointment in pediatrics have not been established.

Safety and efficacy of acyclovir (Zovirax) cream and penciclovir (Denavir) 1% cream in children < 12 years of age have not been established.

Docosanol (Abreva) cream is indicated in patients ≥ 12 years of age. The safety and effectiveness of docosanol have not been established in children.

Acyclovir/hydrocortisone (Xerese) cream 5%/1% is indicated in patients ≥ 6 years of age. The safety and effectiveness of acyclovir/hydrocortisone have not been established in children.

Pregnancy

All agents are Pregnancy Category B except for docosanol. No adequate and well-controlled studies have been performed with docosanol in pregnant women. Labeling for acyclovir/hydrocortisone (Xerese) and penciclovir (Denavir) have been updated to comply with the Pregnancy and Lactation Labeling Rule (PLLR). Labeling for acyclovir/hydrocortisone advises that there are no data for this product regarding use in pregnant women; however, observational studies of either component have not established any drug-related fetal or maternal toxicities. Labeling for penciclovir states that due to lack of systemic absorption use during pregnancy is not expected to result in fetal exposure.

DOSAGES^{62,63,64,65,66,67}

Drug	Patients ≥ 6 years of age	Patients ≥ 12 years of age	Availability
acyclovir cream (Zovirax)	--	Applied 5 times per day for 4 days	5 gm tube of 5% cream
acyclovir ointment (Zovirax)	--	Applied every 3 hours or 6 times per day for 7 days	5 gm, 15 gm, 30 gm tube of 5% ointment
acyclovir/hydrocortisone (Xerese)	Applied 5 times per day for 5 days	--	5 gm tube of 5% acyclovir/1% hydrocortisone cream
docosanol (Abreva)	--	Applied 5 times per day until lesion is healed	2 gm tube of 10% cream; 2 gm tubes of 10% cream (twin pack)
penciclovir (Denavir)	--	Applied every 2 hours during waking hours for a period of 4 days	5 gm tube of 1% cream

CLINICAL TRIALS

Search Strategy

Studies were identified through searches performed on PubMed and review of information sent by manufacturers. Search strategy included the use of all drugs in this class. Randomized, controlled trials studying agents within this class for the FDA-approved indications are considered the most relevant in this category. Studies included for analysis in the review were published in English, performed with human participants, and randomly allocated participants to comparison groups. In addition, studies must contain clearly stated, predetermined outcome measure(s) of known or probable clinical importance, use data analysis techniques consistent with the study question, and include follow-up (endpoint assessment) of at least 80% of participants entering the investigation. Despite some inherent bias found in all studies including those sponsored and/or funded by pharmaceutical manufacturers, the studies in this therapeutic class review were determined to have results or conclusions that do not suggest systematic error in their experimental study design. While the potential influence of manufacturer sponsorship and/or funding must be considered, the studies in this review have also been evaluated for validity and importance.

There are no published head-to-head trials comparing docosanol, acyclovir 5%, and penciclovir in the treatment of herpes labialis. Due to the lack of studies, placebo-controlled trials have been included.

There are no current studies available for acyclovir (Zovirax) ointment. Placebo-controlled studies have been performed and showed that acyclovir ointment was more effective at reducing healing time and, in some cases, duration of viral shedding and pain in immunocompromised patients with herpes labialis.⁶⁸

acyclovir cream (Zovirax) versus penciclovir (Denavir)

A randomized, double-blind, active comparator study enrolling 248 patients with a diagnosis of herpes simplex facialis/labialis compared penciclovir 1% cream and acyclovir 3% cream.⁶⁹ Patients were evaluated before treatment and on days 3, 5, and 7 of treatment. No severe adverse events were recorded in either treatment group. There were no significant differences in the efficacy endpoint or

cure rate between groups, but a trend towards a shorter time to resolution of all symptoms, cessation of new blisters, and loss of crust ($p \leq 0.08$) was seen with the penciclovir group. In addition, the clinical scores in penciclovir treated patients were significantly lower than those in the acyclovir group on days 5 and 7 ($p \leq 0.05$). The study used acyclovir cream at a lower strength than the currently available US formulation (Zovirax 5%).

acyclovir/hydrocortisone cream (Xerese) versus placebo

A randomized, double-blind, placebo-controlled, patient-initiated clinical trial was performed to compare the efficacy of 5% acyclovir/1% hydrocortisone cream for the early treatment of cold sores to decrease the frequency of ulcerative lesions.^{70,71} A total of 2,437 patients with a history of herpes labialis were randomized to self-initiate treatment with 5% acyclovir/1% hydrocortisone cream, 5% acyclovir cream, or placebo at the earliest sign of a cold sore recurrence. The subjects had, on average, 5.6 episodes of herpes labialis in the previous 12 months. The cream was applied 5 times per day for 5 days. A total of 1,443 patients experienced a recurrence and initiated treatment with 5% acyclovir/1% hydrocortisone cream ($n=601$), 5% acyclovir cream ($n=610$), or placebo ($n=232$). Of the patients receiving 5% acyclovir/1% hydrocortisone cream, 42% did not develop an ulcerative lesion compared with 35% receiving 5% acyclovir cream ($p=0.014$) and 26% of patients receiving placebo ($p < 0.001$). The time for ulcerative lesions to heal was reduced by 1.4 days with 5% acyclovir/1% hydrocortisone versus placebo ($p=0.002$; 95% confidence interval [CI], -2.285 to -0.643) and by 0.3 days versus acyclovir ($p=0.297$; 95% CI, -0.901 to -0.276). The mean time for the subject's skin to return to normal was approximately 1.6 days shorter in the subjects treated with combination cream compared to vehicle. Size of the cold sore and symptoms such as tenderness were reduced with combination cream as compared to vehicle. There were no differences among groups in the number of patients with positive herpes simplex virus cultures. All treatment groups had similar side-effect profiles. The 5% acyclovir/1% hydrocortisone cream prevented progression of cold sores to ulcerative lesions and significantly reduced the cumulative lesion area compared with acyclovir cream and placebo.

A double-blind, randomized, placebo-controlled study was performed to compare the efficacy of 5% acyclovir/1% hydrocortisone cream for treatment of UV radiation-induced herpes labialis.⁷² A total of 380 immunocompetent patients received UV radiation (UVR) in order to induce a herpes labialis recurrence. Patients were randomized to receive either 5% acyclovir/1% hydrocortisone cream ($n=190$) or placebo ($n=190$) and were instructed to apply treatment 6 times per day for 5 days, beginning on the morning of the second day after UVR exposure. "Immediate lesions," defined as those that arose within 2 days of UVR are of uncertain etiology and pathophysiology and were noted but not monitored. "Delayed lesions," defined as lesions that occurred 2 to 7 days after exposure to UVR, were evaluated. Of the 380 UVR exposed patients, 120 patients developed delayed lesions and were included in the intent-to-treat population. Fifty (26%) of the 190 patients treated with active drug developed delayed lesions, whereas 70 (37%) of the 190 patients treated with placebo developed delayed lesions, which was a reduction of 29% ($p=0.022$). Healing time, measured as the time to normal skin, was reduced in the active treatment population compared to placebo, 9 days versus 10.1 days ($p=0.04$), respectively. There was a trend toward reduction in the maximum lesion size in the active treatment group by 28% compared to that in the controls (43 mm² versus 60 mm², respectively; $p=0.07$ [not significant]). The active treatment reduced the number of patients with moderate to severe tenderness but had no effect on lesion pain. Compared to placebo, 5% acyclovir/1% hydrocortisone cream provided benefits to patients in reducing lesion incidence, healing time, and lesion tenderness.

penciclovir (Denavir) versus placebo

Two randomized, double-blind, parallel group studies were performed with 3,057 patients of which 83% developed clinical lesions. Patients were given either penciclovir 1% cream or placebo for the treatment of recurrent herpes simplex labialis defined as ≥ 3 episodes a year that typically manifested as classical lesions.⁷³ Patients self-initiated treatment within 1 hour of noticing the first signs and symptoms of a recurrence and were required to apply medication 6 times per day for the first day and every 2 hours while awake for 4 consecutive days. Lesion resolution and lesion pain occurred 31% and 28% faster, respectively, in the penciclovir-treated group than the placebo-treated group ($p=0.0001$ for both). Dosing frequency was vital to treatment outcomes.

docosanol (Abreva) versus placebo

Two identical multicenter, double-blind, placebo-controlled studies were performed with 737 patients who were given either docosanol 10% cream or placebo for the treatment of herpes simplex labialis in the prodrome or erythema stage.⁷⁴ Patients were treated 5 times daily until healing occurred (i.e., the crust fell off spontaneously or there was no longer evidence of an active lesion). The median time to healing in the docosanol-treated group ($n=370$) was 4.1 days, 18 hours shorter than that of the placebo-treated group ($n=367$) ($p=0.008$). The docosanol group also exhibited reduced times from treatment initiation to cessation of pain and all other symptoms ($p=0.002$), complete healing of lesion ($p=0.023$), and cessation of the ulcer or soft crust stage of the lesion ($p<0.001$). Aborted episodes were experienced by 40% of docosanol patients and 34% of placebo patients ($p=0.109$ [not significant]). Adverse events with docosanol were mild and similar to those with placebo. The study concluded that docosanol applied 5 times per day is safe and effective in the treatment of recurrent herpes simplex labialis.

SUMMARY

Herpes labialis is highly prevalent within the US population. The HSV-1 and HSV-2 viruses become reactivated secondary to certain stimuli including fever, upper respiratory infection, physical or emotional stress, ultraviolet light exposure, and axonal injury. Low dose oral antiviral medications have provided a preventative treatment option for patients with recurrent herpes labialis. Topical antiviral medications are used for the treatment of an active lesion and should be started during the prodrome phase, characterized by perioral tingling, itching, and redness, to be most beneficial. The utilization of topical antiviral treatments has increased, especially since the addition of the over-the-counter (OTC) preparation, docosanol (Abreva). Left untreated, herpes labialis may take up to 10 days or more to heal. Compared to placebo, treatment has reduced lesion healing time by approximately 0.75 to 1.5 days in clinical trials.

The pharmacokinetics, contraindication/warnings, drug interactions, and adverse effects are very similar between acyclovir, penciclovir, and docosanol. Likewise, no significant difference exists when examining the products' FDA-approved application frequency and duration of therapy. Overall, acyclovir, penciclovir, and docosanol for herpes labialis treatment only provide modest benefit if used very early in the prodrome phase.

Comparative literature examining topical antiviral therapies is lacking. According to studies, all products are effective in treating herpes labialis and provide symptom relief, such as decreased lesion count, lesion size, pain, and healing time compared to placebo. Penciclovir (Denavir) did provide better clinical scores compared to acyclovir cream in 1 study; however, the study used a lower strength of acyclovir cream (3%) than the currently available US formulation (Zovirax 5%).

The 2015 Centers for Disease Control and Prevention (CDC) sexually-transmitted disease (STD) recommendations for genital herpes state oral antiviral therapy is preferred over topical antiviral therapy.

Xerese is the only prescription cream combination of acyclovir 5% and hydrocortisone 1%. Docosanol (Abreva) is available without a prescription.

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