VISTIDE® (cidofovir injection)

Rx only.

FOR INTRAVENOUS INJECTION ONLY.
NOT FOR INTRACULODULAR INJECTION.

WARNING:
RENAL IMPAIRMENT IS THE MAJOR TOXICITY OF VISTIDE. CASES OF ACUTE
RENAL FAILURE RESULTING IN DIALYSIS AND/OR CONTRIBUTING TO DEATH
HAVE OCCURRED WITH AS FEW AS ONE OR TWO DOSES OF VISTIDE.
TO REDUCE POSSIBLE NEPHROTOXICITY, INTRAVENOUS PREHOCULATION WITH
NORMAL SALINE AND ADMINISTRATION OF PROBENECID MUST BE USED
WITH EACH VISTIDE INFUSION. RENAL FUNCTION (SERUM CREATININE
AND URINE PROTEIN) MUST BE MONITORED WITHIN 48 HOURS PRIOR TO EACH
DOSE OF VISTIDE AND THE DOSE OF VISTIDE MODIFIED FOR CHANGES IN
RENAL FUNCTION AS APPROPRIATE (SEE DOSAGE AND ADMINISTRATION).
VISTIDE IS CONTRAINDICATED IN PATIENTS WHO ARE RECEIVING OTHER
NEPHROTOXIC AGENTS.

NEUTROPENIA HAS BEEN OBSERVED IN ASSOCIATION WITH VISTIDE TREATMENT.
THE EFFECT OF VISTIDE ON NEUTROPHIL COUNTS SHOULD BE MONITORED DURING
VISTIDE THERAPY.

VISTIDE IS INDICATED ONLY FOR THE TREATMENT OF CMV RETINITS IN
PATIENTS WITH ACQUIRED IMMUNODEFICIENCY SYNDROME.

IN ANIMAL STUDIES CIDOFOVIR WAS CARCINOGENIC, TERATOGENIC AND
CAUSED HYPOSPADIAS (SEE CARCINOGENICITY, MUTAGENESIS, AND IMPAIRMENT
OF FERTILITY).

DESCRIPTION
VISTIDE® is the brand name for cidofovir injection. The chemical name of cidofovir
is 1-(5-ethyl-9H-carbazol-9-yl)-2,3-dihydrothiazole-4-carboxylic acid, with the
molecular formula of C22H19N5O3S and a molecular weight of 352.4. The
chemical structure is:

\[
\text{\[
\text{NH}_2 \quad \text{O} \quad \text{O} \\
\text{C}_2\text{H}_3\text{N}_5\text{O}_3\text{S} \quad \text{H}_2\text{O}
\]
\]
\]

Cidofovir is a white crystalline powder with an aqueous solubility of ≥ 170 mg/mL at pH
6-8 and a log P (octanol/aqueous buffer, pH 7.1) value of 3.3.

VISTIDE is a sterile, hypertonic aqueous solution for intravenous injection only. The
solution is clear and colorless. It is supplied in clear glass vials, each containing 375 mg of
anhydrous cidofovir in 5 mL aqueous solution at a concentration of 75 mg/mL. The
formulation is pH-adjusted to 7.4 with sodium hydroxide and/or hydrochloric acid and
contains no preservatives. The appropriate volume of VISTIDE must be removed from the
single-use vial and diluted prior to administration (see DOSAGE AND ADMINISTRATION).

MICROBIOLOGY
Mechanism of Action: Cidofovir suppresses cytomegalovirus (CMV) replication by selective
inhibition of viral DNA synthesis. Biochemical data support selective inhibition of
CMV DNA polymerase by cidofovir. The active intracellular metabolite of
cidofovir, cidofovir diphosphate (CDP), is incorporated into the growing viral DNA chain
results in reductions in the rate of viral DNA synthesis.

In Vitro Susceptibility: Cidofovir is active in vitro against a variety of laboratory and clinical
isolates of CMV and other herpesviruses (Table 1). Controlled clinical studies of efficacy
have been limited to patients with AIDS and CMV retinitis.

<table>
<thead>
<tr>
<th>Virus</th>
<th>IC50 (µM)</th>
</tr>
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<tbody>
<tr>
<td>Wild-type CMV Isolates</td>
<td>0.3 - 2.8</td>
</tr>
<tr>
<td>HSV-1, HSV-2</td>
<td>12.7 - 31.7</td>
</tr>
</tbody>
</table>

Resistance: CMV isolates with reduced susceptibility to cidofovir have been selected in
vitro in the presence of high concentrations of cidofovir. IC50 values for selected resis-
tant isolates ranged from 7-15 µM.

There are insufficient data at this time to assess the frequency or the clinical significance
of the development of resistant isolates following VISTIDE administration to patients.

The possibility of viral resistance should be considered for patients who show a poor
clinical response or experience recurrent retinitis progression during therapy.

Cross Resistance: Cidofovir-resistant isolates selected in vitro following exposure to
increasing concentrations of cidofovir were assessed for susceptibility to ganciclovir and foscamet®. All were cross resistant to ganciclovir, but remained susceptible to foscamet.
Ganciclovir- or ganciclovir- and foscamet-resistant isolates, that are cross resistant to cidofovir have been obtained from drug naive patients and from patients following ganc-
clovir or ganciclovir/ foscamet therapy. To date, the majority of ganci-
clovir-resistant isolates are UL97 gene product (phosphokinase) mutants and remain susceptible to cidofovir. Reduced susceptibility to cidofovir, however, has been reported for DNA polymerase mutants of CMV which are resistant to ganciclovir. To date, all clinical isolates
which exhibit high level resistance to ganciclovir, due to mutations in both the DNA polymerase and UL97 genes, have been shown to be cross resistant to cidofovir. Foscamet is active against some, but not all, CMV isolates which are resistant to foscamet. The incidence of foscamet-resistant isolates that are resistant to cidofovir is not known.

Clinical characterization of these triple-resistant isolates revealed several point mutations in the CMV DNA poly-
merase gene. The clinical significance of the development of these cross-resistant iso-
lates is not known.

CLINICAL PHARMACOLOGY
VISTIDE must be administered with probenecid. The pharmacokinetics of cidofovir, administered both without and with probenecid, are described below.

The pharmacokinetics of cidofovir must be determined in 27 HIV-infected patients with or without asymptomatic CMV infection. Dose-independent pharmacokinetics were determined after 1 hr infusion concentrations of 1.0 (n = 5), 3.0 (n = 10), 5.0 (n = 2) and 10.0 (n = 8) mg/kg (See Table 2 for pharmacokinetic parameters). There was no evidence of cidofovir accumulation after 4 weeks of repeated administration of 3
mg/kg/week (n = 5) without probenecid. In patients with normal renal function, approximately 80 to 100% of the VISTIDE dose was recovered unchanged in urine within 24 hr (n = 27). The renal clearance of cidofovir was greater than creatinine clearance, indicating renal tubular secretion contributes to the elimination of cidofovir.

The pharmacokinetics of cidofovir administered with probenecid were determined in 12
HIV-infected patients with or without asymptomatic CMV infection and 10 patients with
relapsing CMV retinitis. Dose-independent pharmacokinetics were observed for cido-
fovir administered with probenecid, after one hr infusions of 1.0 (n = 12), 5.0 (n = 6),
and 7.5 (n = 4) mg/kg (See Table 2). Approximately 70 to 85% of the VISTIDE dose
administered with concomitant probenecid was excreted as unchanged drug within 24
hr. When VISTIDE was administered with probenecid, the renal clearance of cidofovir
was reduced to a level consistent with creatinine clearance, suggesting that probenecid
blocks active renal tubular secretion of cidofovir.

Table 2. Cidofovir Pharmacokinetic Parameters Following 3.0 and 5.0 mg/kg Infusions, Without and With Probenecid

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>VISTIDE ADMINISTERED WITHOUT PROBENECID</th>
<th>VISTIDE ADMINISTERED WITH PROBENECID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 mg/kg (n = 12)</td>
<td>5 mg/kg (n = 12)</td>
</tr>
<tr>
<td></td>
<td>5 mg/kg (n = 2)</td>
<td>3 mg/kg (n = 12)</td>
</tr>
<tr>
<td></td>
<td>5 mg/kg (n = 6)</td>
<td></td>
</tr>
<tr>
<td>AUC (µg·h/mL)</td>
<td>20.0 ± 2.3</td>
<td>28.3</td>
</tr>
<tr>
<td></td>
<td>25.7 ± 8.5</td>
<td>40.8 ± 9.0</td>
</tr>
<tr>
<td>Cross point of infusion (µg/mL)</td>
<td>7.3 ± 1.4</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>19.6 ± 7.2</td>
<td></td>
</tr>
<tr>
<td>Vss (mL/kg)</td>
<td>537 ± 128</td>
<td>410 ± 102</td>
</tr>
<tr>
<td></td>
<td>410 ± 102</td>
<td></td>
</tr>
<tr>
<td>Clearance (mL/min/1.73 m²)</td>
<td>179 ± 23.1</td>
<td>148 ± 38.8</td>
</tr>
<tr>
<td></td>
<td>(n = 12)</td>
<td>(n = 12)</td>
</tr>
<tr>
<td></td>
<td>(n = 18)</td>
<td></td>
</tr>
<tr>
<td>Renal Clearance (mL/min/1.73 m²)</td>
<td>150 ± 26.9</td>
<td>96.8 ± 27.9</td>
</tr>
<tr>
<td></td>
<td>(n = 12)</td>
<td>(n = 11)</td>
</tr>
</tbody>
</table>

See DOSAGE AND ADMINISTRATION.
in vitro, cidofovir was less than 6% bound to plasma or serum proteins over the cidofovir concentration range 0.25 to 25 µg/mL. CSF concentrations of cidofovir following intravenous infusion of VISTIDE 5 mg/kg with concomitant probenecid and intravenous hydration were undetectable (< 0.1 µg/mL assay detection threshold) at 15 minutes after the end of a 1 hr infusion in one patient whose corresponding serum concentration was 8.7 µg/mL.

**DRUG-DRUG INTERACTIONS**

**Zidovudine**

The pharmacokinetics of zidovudine were evaluated in 10 patients receiving zidovudine alone or with intravenous cidofovir (without probenecid). There was no evidence of an effect of cidofovir on the pharmacokinetics of zidovudine.

**SPECIFIC POPULATIONS**

**Pediatric**

Pharmacokinetic data collected from subjects with creatinine clearance values as low as 11 mL/min indicate that cidofovir clearance decreases proportionally with creatinine clearance.

**High-flux hemodialysis** has been shown to reduce the serum levels of cidofovir by approximately 75%.

**Initiation of therapy with VISTIDE is contraindicated in patients with serum creatinine > 1.5 mg/dL, a calculated creatinine clearance < 55 mL/min, or a urine protein ≥ 100 mg/dL (equivalent to ≥ 2+ proteinuria) (See CONTRAINDICATIONS).**

**Gender/Gender/Race**

The effects of age, gender, and race on cidofovir pharmacokinetics have not been investigated.

**INDICATION AND USAGE**

VISTIDE is indicated for the treatment of CMV retinitis in patients with acquired immunodeficiency syndrome (AIDS). The SAFETY AND EFFICACY OF VISTIDE HAVE NOT BEEN ESTABLISHED FOR TREATMENT OF OTHER CMV INFECTIONS (SUCH AS PNEUMONITIS OR GASTROENTERITIS), CONGENITAL OR NEONATAL CMV DISEASE, OR CMV DISEASE IN NON-HIV-INFECTED INDIVIDUALS.

**DESCRIPTION OF CLINICAL TRIALS**

Three phase I/II controlled trials of VISTIDE have been conducted in HIV-infected patients with CMV retinitis.

**Delayed Versus Immediate Therapy (Study 105):** In stage 1 of this open-label trial, conducted by the Studies of the Ocular Complications of AIDS (SOCOA) Clinical Research Group, 29 previously untreated patients with peripheral CMV retinitis were randomized to either immediate treatment with VISTIDE (5 mg/kg once a week for 2 weeks, then 3 mg/kg every other week) or to have VISTIDE delayed until progression of CMV retinitis. In stage 2 of this trial, an additional 35 previously untreated patients with peripheral CMV retinitis were randomized to either immediate treatment with VISTIDE (5 mg/kg once a week for 2 weeks, then 5 mg/kg every other week), immediate treatment with VISTIDE (5 mg/kg once a week for 2 weeks, then 3 mg/kg every other week), or to have VISTIDE delayed until progression of CMV retinitis. Of the 64 patients in this study, 12 were randomized to 5 mg/kg maintenance therapy, 26 to 3 mg/kg maintenance therapy, and 26 to delayed therapy. Of the 12 patients enrolled in the 5 mg/kg maintenance group, 5 patients progressed, 5 patients discontinued therapy, and patients had no progression at study completion. Based on masked readings of retinal photographs, the median [95% confidence interval (CI)] time to retinitis progression was not reached (25, not reached) for the 5 mg/kg maintenance group. Median (95% CI) time to the alternative endpoint of retinitis progression or study drug discontinuation was 44 days (24, 207) for the 5 mg/kg maintenance group. Patients receiving 5 mg/kg maintenance had delayed time to retinitis progression compared to patients receiving 3 mg/kg maintenance or deferred therapy.

**Delayed Versus Immediate Therapy (Study 106):** In an open-label trial, 48 previously untreated patients with peripheral CMV retinitis were randomized to either immediate treatment with VISTIDE (5 mg/kg once a week for 2 weeks, then 5 mg/kg every other week), or to have VISTIDE delayed until progression of CMV retinitis. Patient baseline characteristics and disposition are shown in Table 3. Of 25 and 23 patients in the immediate and delayed groups, respectively, 23 and 21 were evaluable for retinitis progression as determined by retinal photography. Based on masked readings of retinal photographs, the median [95% confidence interval (CI)] time to retinitis progression was 120 days (40, 134) and 22 days (10, 27) for the immediate and delayed therapy groups, respectively. This difference was statistically significant. However, because of the limited number of patients remaining on treatment over time (3 of 25 patients received VISTIDE for 120 days or longer), the median time to progression for the immediate therapy group was difficult to precisely estimate. Median (95% CI) times to the alternative endpoint of retinitis progression or study drug discontinuation (including adverse events, withdrawn consent, and systemic CMV disease) were 52 days (37, 85) and 22 days (13, 27) for the immediate and delayed therapy groups, respectively. This difference was statistically significant. Time to progression estimates from this study may not be directly comparable to estimates reported for other therapies.

**Table 3. Patient Characteristics and Disposition (Study 106)**

<table>
<thead>
<tr>
<th>Immediate Therapy (n = 25)</th>
<th>Delayed Therapy (n = 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38</td>
</tr>
<tr>
<td>Sex (MF)</td>
<td>24/1</td>
</tr>
<tr>
<td>Median CD4 Cell Count</td>
<td>6</td>
</tr>
<tr>
<td>Endpoints</td>
<td></td>
</tr>
<tr>
<td>CMV Retinitis Progression</td>
<td>10</td>
</tr>
<tr>
<td>Discontinued Due to Adverse Event</td>
<td>6</td>
</tr>
<tr>
<td>Withdrawn Consent</td>
<td>3</td>
</tr>
<tr>
<td>Discontinued Due to Intercurrent Illness</td>
<td>2</td>
</tr>
<tr>
<td>Discontinued Based on Ophtalmological Examination</td>
<td>1</td>
</tr>
<tr>
<td>No Progression at Study Completion</td>
<td>1</td>
</tr>
<tr>
<td>Not Evaluated at Baseline</td>
<td>2</td>
</tr>
</tbody>
</table>

* One patient died 2 weeks after withdrawing consent.
* Two patients on immediate therapy were diagnosed with CMV disease and discontinued from study. One patient on delayed therapy was diagnosed with CMV gastrointestinal disease.
* CMV retinitis progression not confirmed by retinal photography.

**Dose-response study of VISTIDE (Study 107):** In an open-label trial, 100 patients with relapsing CMV retinitis were randomized to receive 5 mg/kg once a week for 2 weeks and then either 5 mg/kg (n = 49) or 3 mg/kg (n = 51) every other week. Enrolled patients had been diagnosed with CMV retinitis an average of 390 days prior to randomization and had received a median of 3.8 prior courses of systemic CMV therapy. Eighty-four of the 100 patients were considered evaluable for progression by serial retinal photographs (43 randomized to 5 mg/kg and 41 randomized to 3 mg/kg). Twenty-six and 21 patients discontinued therapy due to either an adverse event, intercurrent illness, excluded medication, or withdrawn consent in the 5 mg/kg and 3 mg/kg groups, respectively. Thirty-eight of the 100 randomized patients had progressed according to masked assessment of serial retinal photographs (13 randomized to 5 mg/kg and 25 randomized to 3 mg/kg). Using retinal photographs, the median (95% CI) times to retinitis progression for the 5 mg/kg and 3 mg/kg groups were 115 days (70, not reached) and 49 days (35, 52), respectively. This difference was statistically significant. Similar to Study 106, the median time to retinitis progression for the 5 mg/kg group was difficult to precisely estimate due to the limited number of patients remaining on treatment over time (4 of the 49 patients in the 5 mg/kg group were treated for 115 days or longer). Median (95% CI) times to the alternative endpoint of retinitis progression or study drug discontinuation were 49 days (38, 63) and 35 days (27, 39) for the 5 mg/kg and 3 mg/kg groups, respectively. This difference was statistically significant.

**CONTRAINDICATIONS**

Initiation of therapy with VISTIDE is contraindicated in patients with a serum creatinine > 1.5 mg/dL, a calculated creatinine clearance < 55 mL/min, or a urine protein ≥ 100 mg/dL (equivalent to ≥ 2+ proteinuria).

VISTIDE is contraindicated in patients receiving agents with nephrotoxic potential. Such agents must be discontinued at least seven days prior to starting therapy with VISTIDE.

VISTIDE is contraindicated in patients with hypersensitivity to cidofovir.

VISTIDE is contraindicated in patients with a history of clinically severe hypersensitivity to probenecid or other sulfa-containing medications.

Direct intracocular injection of VISTIDE is contraindicated; direct injection of cidofovir has been associated with iritis, uveitis hypertony, and permanent impairment of vision.

**WARNINGS**

**Nephrotoxicity:** Dose-dependent nephrotoxicity is the major dose-limiting toxicity...
related to VISTIDE administration. Cases of acute renal failure resulting in dialysis and/or contributing to death have occurred with as few as one or two doses of VISTIDE. Renal function (serum creatinine and/or urine protein) must be monitored within 48 hours prior to each dose of VISTIDE. Dose adjustment or discontinuation is required for changes in renal function (serum creatinine and/or urine protein) while on therapy. Proteinuria, as measured by urinalysis in a clinical laboratory, may be an early indicator of VISTIDE-related nephrotoxicity. Continued administration of VISTIDE may lead to additional proximal tubular cell injury, which may result in glycosuria, decreases in serum phosphate, uric acid, and bicarbonate, elevations in serum creatinine, and/or acute renal failure, in some cases, resulting in the need for dialysis. Patients with these adverse events occurring concurrently and meeting a criteria of Fanconi’s syndrome have been reported. Renal function that did not return to baseline after drug discontinuation has been observed in clinical studies of VISTIDE.

Intravenous normal saline hydration and oral probenecid must accompany each VISTIDE infusion. Probenecid is known to interact with the metabolism or renal tubular excretion of many drugs (see DRUG INTERACTIONS). The safety of VISTIDE has not been evaluated in patients receiving other known potentially nephrotoxic agents, such as intravenous aminoglycosides (e.g., tobramycin, gentamicin, and amikacin), amphotericin B, foscarnet, intravenous pentamidine, vancomycin, and non-steroidal anti-inflammatory agents (see DOSAGE AND ADMINISTRATION).

Premedication: Initiation of therapy with VISTIDE is contraindicated in patients with a baseline serum creatinine > 1.5 mg/dL, a creatinine clearance < 55 mL/min, or a urine protein > 100 mg/dL (equivalent to > 2+ proteinuria).

Hematologic Toxicity: Neutropenia may occur during VISTIDE therapy. Neutrophil count should be monitored while receiving VISTIDE therapy.

Decreased Intravascular Pressure/Intravascular Hypotension: Decreased intravascular pressure may occur during VISTIDE therapy, and in some instances has been associated with decreased visual acuity. Intravascular pressure should be monitored during VISTIDE therapy.

Metabolic Acidosis: Decreased serum bicarbonate associated with proximal tubule injury and renal wasting syndrome (including Fanconi's syndrome) have been reported in patients receiving VISTIDE (see ADVERSE REACTIONS). Cases of metabolic acidosis in association with liver dysfunction and pancreatitis resulting in death have been reported in patients receiving VISTIDE.

PRECAUTIONS

General

Due to the potential for increased nephrotoxicity, doses greater than the recommended dose must not be administered and the frequency or rate of administration must not exceed (see DOSAGE AND ADMINISTRATION).

VISTIDE is formulated for intravenous infusion only and must not be administered by intravenous injection. Administration of VISTIDE by infusion must be accompanied by oral probenecid and intravenous saline prehydration (see DOSAGE AND ADMINISTRATION).

Urinalysis

Urinals or urins was reported in clinical trials and during postmarketing in patients receiving VISTIDE therapy. Treatment with topical cycloplegics or with or without topical cycloplegics should be considered. Patients should be monitored for signs and symptoms of urinals/urins during VISTIDE therapy.

Information for Patients

Patients should be advised that VISTIDE is not a cure for CMV reinitis, and that they may continue to experience progression of reinitis during and following treatment. Patients receiving VISTIDE should be advised to have regular follow-up ophthalmologic examinations. Patients may also experience other manifestations of CMV disease despite VISTIDE therapy.

HIV-infected patients may continue taking antiretroviral therapy, but those taking zidovudine should be advised to temporarily discontinue zidovudine administration or decrease their zidovudine dose by 50%, on days of VISTIDE administration only, because probenecid reduces metabolic clearance of zidovudine.

Patients should be informed of the major toxicity of VISTIDE, namely renal impairment, and that dose modification, including reduction, interruption, and possibly discontinuation, may be required. Close monitoring of renal function (routine urinalysis and serum creatinine) while on therapy should be emphasized.

The importance of completing a full course of probenecid with each VISTIDE dose should be emphasized. Patients should be warned of potential adverse events caused by probenecid (e.g., headache, nausea, vomiting, and hypersensitivity reactions). Hypersensitivity reactions may include rash, fever, chills, or anaphylaxis. Administration of probenecid after a meal or use of antacids may decrease the nausea. Prophylactic or therapeutic antihistamines and/or acetaminophen can be used toameliorate hypersensitivity reactions.

Patients should be advised that cidofovir causes tumors, primarily mammary adenocarcinomas, in rats. VISTIDE should be considered a potential carcinogen in humans (See Carcinogenesis, Mutagenesis, & Impairment of Fertility). Women should be advised of the limited enrollment of women in clinical trials of VISTIDE.

Patients should be advised that VISTIDE caused reduced taste weight and hypoglycemia in animals. Such changes may occur in humans and cause infertility. Women of childbearing potential should be advised that cidofovir is embryotoxic in animals and should not be used during pregnancy. Women of childbearing potential should be advised to use effective contraception during and for 1 month following treatment with VISTIDE. Men should be advised to practice barrier contraceptive methods during and for 3 months after treatment with VISTIDE.

Drug Interactions

Probenecid: Probenecid is known to interact with the metabolism or renal tubular excretion of many drugs (e.g., acemetidine, acyclovir, angiotensin-converting enzyme inhibitors, aminosalicylic acid, barbiturates, benzodiazepines, benzotiazepine, cidofovir, methotrexate, famotidine, furosemide, nonsteroidal anti-inflammatory agents, theophylline, and zidovudine). Concomitant medications should be carefully assessed. Zidovudine should either be temporarily discontinued or decreased by 50% when coadministered with probenecid on the day of VISTIDE infusion.

Nephrotoxic agents: Concomitant administration of VISTIDE and agents with nephrotoxic potential (e.g., intravenous aminoglycosides [e.g., tobramycin, gentamicin, and amikacin], amphotericin B, foscarnet, intravenous pentamidine, vancomycin, and non-steroidal anti-inflammatory agents) is contraindicated. Such agents must be discontinued at least seven days prior to starting therapy with VISTIDE.

Carcinogenesis, Mutagenesis, & Impairment of Fertility

Chronic, two-year carcinogenicity studies in rats and mice have not been carried out to evaluate the carcinogenic potential of cidofovir. However, a 26-week toxicology study evaluating once weekly subcutaneous subcutaneous injections of cidofovir in rats was terminated at 19 weeks because of the induction, in females, of palpable masses; the first of which was detected after administration of six doses. The masses were diagnosed as mammary adenocarcinomas which developed at doses as low as 0.6 mg/kg/week, equivalent to 0.04 times the human systemic exposure at the recommended intravenous VISTIDE dose based on AUC comparisons.

In a 26-week intravenous toxicology study in which rats received 0.6, 3, or 15 mg/kg cidofovir once weekly, a significant increase in mammary adenocarcinomas in female rats as well as a significant incidence of Zymbal’s gland carcinomas in male and female rats were seen at the high dose but not at the lower two doses. The high dose was equivalent to 1.1 times the human systemic exposure at the recommended dose of VISTIDE, based on comparisons of AUC measurements. In light of the results of these studies, cidofovir should be considered to be a carcinogen in rats as well as a potential carcinogen in humans.

Cynomolgus monkeys received intravenous cidofovir, alone and in conjunction with concomitant oral probenecid, intravenously once weekly for 52 weeks at doses resulting in exposures of approximately 0.7 times the human systemic exposure at the recommended dose of VISTIDE. No tumors were detected. However, the study was not designed as a carcinogenicity study due to the small number of animals at each dose and the short duration of treatment.

No mutagenic response was observed in microbial mutagenicity assays involving Salmonella typhimurium (Ames) and Escherichia coli in the presence and absence of metabolic activation. An increase in micronucleated polychromatic erythrocytes in vitro was seen in mice receiving > 2000 mg/kg, a dosage approximately 65-fold higher than the maximum recommended clinical intravenous VISTIDE dose based on body surface area estimations. Cidofovir induced chromosomal aberrations in human peripheral blood lymphocytes in vitro without metabolic activation. At the 4 cidofovir levels tested, the percentage of damaged metaphases and number of aberrations per cell increased in a concentration-dependent manner.

Studies showed that cidofovir caused inhibition of spermatogenesis in rats and monkeys. However, no adverse effects on fertility or reproduction were seen following once weekly intravenous injections of cidofovir in male rats for 13 consecutive weeks at doses up to 15 mg/kg/week (equivalent to 1.1 times the recommended human dose based on AUC comparisons). Female rats dosed intravenously once weekly at 1.2 mg/kg/week (equivalent to 0.09 times the recommended human dose based on AUC)
or higher, for up to 6 weeks prior to mating and for 2 weeks post mating had decreased litter sizes and live births per litter and increased early resorptions per litter. Peri- and postnatal development studies in which female rats received subcutaneous injections of cidofovir once daily at doses up to 1.0 mg/kg/day from day 7 of gestation through day 21 postpartum (approximately 5 weeks) resulted in no adverse effects on viability, growth, behavior, sexual maturation or reproductive capacity in the offspring.

Pregnancy: Category C

Cidofovir was embryotoxic (reduced fetal body weights) in rats at 1.5 mg/kg/day and in rabbits at 0.0 mg/kg/day; doses which were also maternally toxic, following daily intravenous dosing during the period of organogenesis. The no-observed-effect levels for embryotoxicity in rats (0.5 mg/kg/day) and in rabbits (0.25 mg/kg/day) were approximately 0.04 and 0.05 times the clinical dose (5 mg/kg every other week) based on AUC, respectively. An increased incidence of fetal external, soft tissue and skeletal anomalies (meningocel, short snout, and short maxillary bones) occurred in rabbits at the high dose (1.0 mg/kg/day) which was also maternally toxic. There are no adequate and well-controlled studies in pregnant women. VISTIDE should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nursing Mothers

It is not known whether cidofovir is excreted in human milk. Since many drugs are excreted in human milk and because of the potential for adverse reactions as well as the potential for tumorigenicity shown for cidofovir in animal studies, VISTIDE should not be administered to nursing mothers. The U.S. Public Health Service Centers for Disease Control and Prevention advises HIV-infected women not to breast-feed to avoid postnatal transmission of HIV to a child who may not yet be infected.

Pediatric Use

Safety and effectiveness in children have not been studied. The use of VISTIDE in children with AIDS warrants extreme caution due to the risk of long-term carcinogenicity and reproductive toxicity. Administration of VISTIDE to children should be undertaken only after careful evaluation and only if the potential benefits of treatment outweigh the risks.

Geriatric Use

No studies of the safety or efficacy of VISTIDE in patients over the age of 60 have been conducted. Since elderly individuals frequently have reduced glomerular filtration, particular attention should be paid to assessing renal function before and during VISTIDE administration (see DOSAGE AND ADMINISTRATION).

ADVERSE REACTIONS

1. Neuprotection: Neutropenia, as manifested by a decrease in the number of neutrophils (less than 1,500/µL), occurred in 30% of patients receiving VISTIDE at a maintenance dose of 5 mg/kg every other week. Neutropenia was observed in 12 of 41 (29%) patients who had received prior therapy for CMV retinitis (Study 106) and in 19 of 74 (26%) patients who had received prior therapy for CMV retinitis (Study 107). Prior herpesvirus infection may result in a higher frequency of neutropenia. Administration of VISTIDE to patients with herpesvirus infection has not been evaluated in clinical studies. (See CONTRAINDICATIONS, WARNINGS, DOSAGE AND ADMINISTRATION).

2. Neutropenia: In clinical trials, at the 5 mg/kg maintenance dose, a decrease in absolute neutrophil count to 500 cells/µL occurred in 24% of patients. Granulocyte colony-stimulating factor (G-CSF) was used in 39% of patients.

3. Decreased Intravascular Pressure/Ocular Hypotony: Among the subset of patients monitored for intravascular pressure changes, a > 50% decrease from baseline intravenous pressure was reported in 17 of 70 (24%) patients at the 5 mg/kg maintenance dose. Severe hypotension (intravascular pressure of 0-1 mm Hg) has been reported in 3 patients. Risk of ocular hypotony may be increased in patients with preexisting diabetes mellitus.

4. Anterior Uveitis/Iritis: Anterior uveitis has been reported in clinical trials and during postmarketing surveillance in patients receiving VISTIDE therapy. Uveitis or iritis was reported in 15 of 35 (11%) patients receiving 5 mg/kg maintenance dosing. Treatment with topical corticosteroids with or without topical cycloplegic agents may be considered. Patients should be monitored for signs and symptoms of anterior uveitis/iritis during VISTIDE therapy.

5. Metabolic Acidosis: A diagnosis of Fanconi's syndrome, as manifested by multiple abnormalities of proximal renal tubular function, was reported in 1% of patients. Decreases in serum bicarbonate to ≤ 16 mEq/L occurred in 13 of cidofovir-treated patients. Cases of metabolic acidosis in association with liver dysfunction and pancreatitis resulting in death have been reported in patients receiving VISTIDE.

In clinical trials, VISTIDE was withdrawn due to adverse events in 39% of patients treated with 5 mg/kg every other week as maintenance therapy. The incidence of adverse reactions reported as serious in three controlled clinical studies in patients with CMV retinitis, regardless of presumed relationship to drug, is listed in Table 4.

Table 4. Serious Clinical Adverse Events or Laboratory Abnormalities Occurring in > 1% of Patients

<table>
<thead>
<tr>
<th>AE</th>
<th>N = 135*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>68 (50)</td>
</tr>
<tr>
<td>Neutropenia (ANC &lt;1000/µL)</td>
<td>33 (24)</td>
</tr>
<tr>
<td>Decreased Intravascular Pressure†</td>
<td>17 (24)</td>
</tr>
<tr>
<td>Decreased Serum Bicarbonate ≤ 16 mEq/L</td>
<td>21 (16)</td>
</tr>
<tr>
<td>Fever</td>
<td>10 (14)</td>
</tr>
<tr>
<td>Infection</td>
<td>18 (13)</td>
</tr>
<tr>
<td>Creatinine Elevation (≥ 2.0 mg/dL)</td>
<td>16 (12)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>12 (9)</td>
</tr>
<tr>
<td>Anorexia/Appendicitis</td>
<td>11 (8)</td>
</tr>
<tr>
<td>Seizures/Convulsions</td>
<td>10 (7)</td>
</tr>
</tbody>
</table>

* Patients receiving 5 mg/kg maintenance regimen in Studies 105, 106 and 107.
† Defined as decreased intravascular pressure (IP) ≤ 50% that at baseline. Based on 70 patients receiving 5 mg/kg maintenance dosing (Studies 105, 106 and 107), for whom baseline and follow-up IP determinations were recorded.

The most frequently reported adverse events regardless of relationship to study drugs (cidofovir or placebo) or severity are shown in Table 5.

The following additional list of adverse events/morbid conditions have been observed in clinical studies of VISTIDE and are listed below regardless of causal relation to VISTIDE. Evaluation of these reports was difficult because of the diverse manifestations of the underlying disease and because most patients received numerous concomitant medications.

Body as a Whole: abdominal pain, accidental injury, AIDS, allergic reaction, back pain, catheter blockage, cellulitis, chest pain, chills, fever, cryptococcosis, cyst, death, fever, flu-like syndrome, hypothyroidism, ileus, injection site reaction, malaise, mucous membrane disorder, neck pain, overdose, photosensitivity reaction, sepsis, septicemia

Cardiovascular System: cardiomyopathy, cardiovascular disorder, congestive heart failure, hypertension, hypoventilation, malignancy, pallor, peripheral vascular disorder, phlebitis, postural hypotension, shock, syncope, tachycardia, vascular disorder, edema

Digestive System: cholangitis, colitis, constipation, esophagitis, dyspepsia, dysphagia, fecal incontinence, flatulence, gastritis, gastrointestinal hemorrhage, gingivitis, hepatitis, hepatitis B, hepatitis C, hepatitis D, hepatitis E, hepatitis G, hepatitis, hepatomegaly, hepatosplenomegaly, jaundice, abnormal liver function, liver damage, liver necrosis, melena, pancreatitis, proctitis, rectal disorder, stomatitis, aphthous stomatitis, tongue discoloration, mouth ulceration, tooth caries

Endocrine System: adrenal cortex insufficiency

Hemic & Lymphatic System: hypocromic anemia, leukocytosis, leucopenia, lymphadenopathy, lymphoma like reaction, pancyclopenia, splenic disorder, splenomegaly, thrombocytopenia, thrombocytopenic purpura

Metabolic & Nutritional System: cachexia, dehydradation, edema, hypertension, hyperglycemia, hyperkalemia, hyperlipidemia, hypercalcemia, hyperuricemia, hypoglycemic reaction, hypokalemia, hypomagnesemia, hypotension, hyperphosphatemia, hyperproteinemia, increased alkaline phosphatase, increased BUN, increased creatinine, dehydradation, increased SGOT, increased SGPT, peripheral edema, respiratory alkalosis, nausea, weight loss, weight gain

Musculoskeletal System: arthralgia, arthritis, bone necrosis, bone pain, joint disorder, leg cramps, myalgia, myopathy, pathological fracture

Nervous System: abnormal dreams, abnormal gait, acute brain syndrome, agitation,
amnesia, anxiety, ataxia, cerebrovascular disorder, confusion, convulsion, delirium, dementia, depression, dizziness, drug dependence, dry mouth, encephalopathy, facial paralysis, hallucinations, hemiplegia, hyperesthesia, hypotonia, hypothyroidism, incoordination, increased libido, insomnia, myoclonus, nervousness, neuropathy, parasthesia, personality disorder, somnolence, speech disorder, tremor, twitching, vasodilatation, vertigo

Respiratory System: asthma, bronchitis, epistaxis, hemoptysis, hiccup, hyperventilation, hoarseness, increased secretions, larynx edema, lung disorder, pharyngitis, pneumonia, rhinitis, sinusitis

Skin & Appendages: acne, angioedema, dry skin, eczema, exfoliative dermatitis, furunculosis, herpes simplex, nail disorder, pruritus, rash, seborrhea, skin discoloration, skin disorder, skin hypertrophy, skin ulcer, sweating, urticaria

Special Senses: abnormal vision, amblyopia, blindness, cataaraxis, conjunctivitis, corneal lesion, corneal opacity, diplopia, dry eyes, ear disorder, eye pain, eye disorder, eye pain, hyperacuity, iritis, keratitis, miosis, oculi externa, oculi media, refraction disorder, retinal detachment, retinal disorder, taste perversion, tinnitus, visual field defect, hearing loss

Urogenital System: decreased creatinine clearance, dysuria, glycemia, hematuria, kidney stone, metritis, micturition, nocturia, polyuria, prostatic disorder, toxic nephropathy, urethritis, urinary casts, urinary incontinence, urinary retention, urinary tract infection

Table 5. All Clinical Adverse Events, Laboratory Abnormalities or Intercurrent Illnesses Regardless of Severity Occurring in ≥ 15% of Patients

<table>
<thead>
<tr>
<th>Event Description</th>
<th>N (%)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Adverse Event</td>
<td>115 (100)</td>
<td>100%</td>
</tr>
<tr>
<td>Proteinuria (&gt; 30 mg/dL)</td>
<td>101 (88)</td>
<td>88%</td>
</tr>
<tr>
<td>Nausea &amp; Vomiting</td>
<td>79 (69)</td>
<td>69%</td>
</tr>
<tr>
<td>Fever</td>
<td>67 (58)</td>
<td>58%</td>
</tr>
<tr>
<td>Neutropenia (&lt; 750 cells/μL)</td>
<td>50 (43)</td>
<td>43%</td>
</tr>
<tr>
<td>Anemia</td>
<td>50 (43)</td>
<td>43%</td>
</tr>
<tr>
<td>Headache</td>
<td>34 (30)</td>
<td>30%</td>
</tr>
<tr>
<td>Rash</td>
<td>34 (30)</td>
<td>30%</td>
</tr>
<tr>
<td>Infection</td>
<td>32 (28)</td>
<td>28%</td>
</tr>
<tr>
<td>Alopecia</td>
<td>31 (27)</td>
<td>27%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>30 (26)</td>
<td>26%</td>
</tr>
<tr>
<td>Pain</td>
<td>29 (25)</td>
<td>25%</td>
</tr>
<tr>
<td>Creatine Elevation (&gt; 1.5 mg/dL)</td>
<td>28 (24)</td>
<td>24%</td>
</tr>
<tr>
<td>Anemia</td>
<td>28 (24)</td>
<td>24%</td>
</tr>
<tr>
<td>Anorexia</td>
<td>26 (23)</td>
<td>23%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>26 (23)</td>
<td>23%</td>
</tr>
<tr>
<td>Chills</td>
<td>25 (22)</td>
<td>22%</td>
</tr>
<tr>
<td>Increased Cough</td>
<td>22 (19)</td>
<td>19%</td>
</tr>
<tr>
<td>Oral Mucositis</td>
<td>21 (18)</td>
<td>18%</td>
</tr>
</tbody>
</table>

* Patients receiving 5 mg/kg maintenance regimen in Studies 106 and 107.

### Reporting of Adverse Reactions

Malignancies or serious adverse reactions that occur in patients who have received VISTIDE should be reported to Gilead in writing to the Director of Clinical Research, Gilead Sciences, Inc., 333 Lakeside Drive, Foster City, CA 94404 or by calling 1-800-GILEAD-5 (445-3235), or to FDA MedWatch 1-800-FDA-1088 or fax 1-800-FDA-0178.

### OVERDOSE

Two cases of cidofovir overdose have been reported. These patients received single doses of VISTIDE at 16.3 mg/kg and 17.4 mg/kg, respectively, with concomitant oral probenecid and intravenous hydration. In both cases, the patients were hospitalized and received oral probenecid (one gram three times daily) and vigorous intravenous hydration with normal saline for 3 to 5 days. Significant changes in renal function were not observed in either patient.

### DOSAGE AND ADMINISTRATION

VISTIDE MUST NOT BE ADMINISTERED BY INTRAOCULAR INJECTION.

### Dosage

The recommended dosage, frequency, or infusion rate must not be exceeded. VISTIDE MUST BE DILUTED IN 100 MILLILITERS 0.9% (NORMAL) SALINE PRIOR TO ADMINISTRATION. TO MINIMIZE POTENTIAL NEPHROTOXICITY, PROBENECID AND INTRAVENOUS SALINE PREHYDRATION MUST BE ADMINISTERED WITH EACH VISTIDE INFUSION.

### Induction Treatment

The recommended induction dose of VISTIDE for patients with a serum creatinine of ≤ 1.5 mg/dL is calculated creatinine clearance = 55 mL/min, and a urine protein < 100 mg/dL (equivalent to < 2+ proteinuria) is 5 mg/kg body weight (given as an intravenous infusion at a constant rate over 1 hr) administered once weekly for two consecutive weeks. Because serum creatinine in patients with advanced AIDS and CMV reinitis may not provide a complete picture of the patient's underlying renal status, it is important to utilize the Cockcroft-Gault formula to more precisely estimate creatinine clearance (GFR). As creatinine clearance is dependent on serum creatinine and patient weight, it is necessary to calculate clearance prior to initiation of VISTIDE. GFR (mL/min) should be calculated according to the following formula:

Creatinine clearance for males →

\[
\text{[140-age (years)] \times \text{body wt. (kg)}} / 72 \times [\text{serum creatinine (mg/dL)}]
\]

Creatinine clearance for females →

\[
\text{[140-age (years)] \times \text{body wt. (kg)}} / 72 \times [0.85 \times \text{serum creatinine (mg/dL)}]
\]

### Maintenance Treatment

The recommended maintenance dose of VISTIDE is 5 mg/kg body weight (given as an intravenous infusion at a constant rate over 1 hr), administered once every 2 weeks.

### Dose Adjustment

Changes in Renal Function During VISTIDE Therapy: The maintenance dose of VISTIDE must be reduced from 5 mg/kg to 3 mg/kg for an increase in serum creatinine of 0.3 - 0.4 mg/dL above baseline. VISTIDE therapy must be discontinued for an increase in serum creatinine of ≥ 0.5 mg/dL above baseline or development of ≥ 3+ proteinuria.

PREEXISTING RENAL IMPAIRMENT: VISTIDE is contraindicated in patients with a serum creatinine concentration > 1.5 mg/dL, a calculated creatinine clearance ≤ 55 mL/min, or a urine protein ≥ 100 mg/dL (equivalent to ≥ 2+ proteinuria).

PROBENECID: Probenecid must be administered orally with each VISTIDE dose. Two grams must be administered 3 hr prior to the VISTIDE dose and one gram administered at 2 and again at 8 hr after completion of the 1 hr VISTIDE infusion (for a total of 4 grams).

Ingestion of food prior to each dose of probenecid may reduce drug-related nausea and vomiting. Administration of an antiemetic may reduce the potential for nausea associated with probenecid ingestion. In patients who develop allergic or hypersensitivity symptoms to probenecid, the use of an appropriate prophylactic or therapeutic antihistamine and/or acetylcysteine should be considered (see CONTRAINDICATIONS).

Hydration: Patients must receive at least one liter of 0.9% (normal) saline solution intravenously with each infusion of VISTIDE. The saline solution should be infused over a 1.2 hr period immediately before the VISTIDE infusion. Patients who can tolerate the additional fluid load should receive a second liter if, after the second liter of saline is administered, the patient remains in the intensive care unit for an additional 24 hr period.

### Method of Preparation and Administration

Inspect ampoules visually for particulate matter and discoloration prior to administration. If particulate matter or discoloration is observed, the vial should not be used. With a syringe, extract the appropriate volume of VISTIDE from the vial and transfer the dose to an infusion bag containing 100 mL 0.9% (normal) saline solution. Infuse the entire volume intravenously into the patient at a constant rate over a 1 hr period. Use of a standard infusion pump for administration is recommended.

It is recommended that VISTIDE infusion admixtures be administered within 24 hr of preparation and that refrigerator or freezer storage not be used to extend this 24 hr limit. If admixtures are not intended for immediate use, they may be stored under refrigeration (2-8°C) for no more than 24 hr. Refrigerated admixtures should be allowed to equilibrate to room temperature prior to use.

The chemical stability of VISTIDE admixtures was demonstrated in polyvinyl chloride composition and ethylene/polypropylene copolymer composition commercial infusion bags, and in glass bottles. No data are available to support the addition of other drugs or supplements to the cidofovir admixture for concurrent administration.

VISTIDE is supplied in single-use vials. Partially used vials should be discarded (see
Handling and Disposal

Compatibility with Ringer's solution, Lactated Ringer's solution or bacteriostatic infusion fluids has not been evaluated.

Handling and Disposal

Due to the mutagenic properties of cidofovir, adequate precautions including the use of appropriate safety equipment are recommended for the preparation, administration, and disposal of VISTIDE. The National Institutes of Health presently recommends that such agents be prepared in a Class II laminar flow biological safety cabinet and that personnel preparing drugs of this class wear surgical gloves and a closed front surgical-type gown with knit cuffs. If VISTIDE contacts the skin, wash membranes and flush thoroughly with water. Excess VISTIDE and all other materials used in the admixture preparation and administration should be placed in a leak-proof, puncture-proof container. The recommended method of disposal is high temperature incineration.

Patient Monitoring

Serum creatinine and urine protein must be monitored within 48 hours prior to each dose. White blood cell counts with differential should be monitored prior to each dose. In patients with proteinuria, intravenous hydration should be administered and the test repeated. Intravascular pressure, visual acuity and ocular symptoms should be monitored periodically.

HOW SUPPLIED

VISTIDE (cidofovir injection) 75 mg/ml, for intravenous infusion, is supplied as a non-preserved solution in single-use clear glass vials as follows:

NDC 61958-0101-1
375 mg in a 5 ml vial in a single-unit carton

VISTIDE should be stored at controlled room temperature 20°-25°C (68°-77°F).

Manufactured by:
Ben Venue Laboratories, Inc.
Bedford, OH 44146-0568

Manufactured for and distributed by:
Gilead Sciences, Inc.
333 Lakeside Drive
Forster City, CA 94404

VISTIDE (cidofovir injection) is covered by U.S. Patent No. 5,142,051 and its foreign counterparts. Other patents pending.

REFERENCES


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