

CYTARABINE FOR INJECTION

Presentation

Cytarabine Solution for Injection 20 mg/mL, 50 mg/mL and 100 mg/mL is a sterile solution of Cytarabine BP in Water for Injections.

Uses

Actions

Cytarabine is an antineoplastic agent. Cytarabine is a synthetic pyrimidine nucleoside, which is converted intracellularly to the nucleotide, cytarabine triphosphate. The exact mechanism of action of cytarabine is not fully understood, but cytarabine triphosphate appears to inhibit DNA synthesis by the inhibition of DNA polymerase. Cytarabine's actions are cell-cycle specific. Cytarabine is also immunosuppressant and has demonstrated antiviral activity *in vitro*.

Pharmacokinetics

Cytarabine is not effective when administered orally. It is rapidly and widely distributed into tissues. Cytarabine crosses the blood-brain barrier to a limited extent and also apparently crosses the placenta. After rapid IV injection, plasma concentrations of cytarabine appear to decline in a biphasic manner with an initial distribution half-life of about 10 minutes, followed by an elimination half-life of about 1-3 hours.

Cytarabine is rapidly metabolised, mainly in the liver, to the inactive metabolite 1- β -D-arabinofuranosyluracil. About 70 to 80% of a dose is excreted in the urine within 24 hours; approximately 90% as the metabolite and 10% as unchanged cytarabine.

Indications

Cytarabine may be used alone or in combination with other chemotherapeutic agents. It is indicated for induction of remission of leukaemia, particularly for acute myeloid leukaemia, in adults and children.

Cytarabine has been used for remission induction in acute lymphocytic leukaemia, chronic myeloid leukaemia and erythroleukaemia; and in the treatment and maintenance therapy of meningeal leukaemia and other meningeal neoplasms.

Children with non-Hodgkin's lymphoma have benefitted from a combination drug programme (LSA2L2) that includes Cytarabine.

Dosage and administration

Being orally inactive, cytarabine is administered by a variety of parenteral routes: subcutaneously, intravenously either as a bolus "push" or as a continuous infusion, or intrathecally.

N.B.: Cytarabine Injection 100 mg/mL is hypertonic and therefore unsuitable for intrathecal use.

Thrombophlebitis has occurred at the site of drug injection or infusion in some patients. Pain and inflammation at subcutaneous injection sites are rare. Subcutaneous injection sites should be rotated around the areas of body fat: the abdomen, thighs and flank region. The drug is generally well tolerated in most instances.

Higher total doses can be better tolerated when administered by rapid IV injection as compared to slow infusion. Such a phenomenon can be explained by the rapid inactivation of the drug and the brief exposure of susceptible normal neoplastic cells to significant levels after rapid injection.

Normal and neoplastic cells appear to respond in almost parallel manner to these two modes of administration and no distinct advantage has been established for either.

Clinical experience to date indicates that success with cytarabine therapy depends more on adeptness in modifying day-to-day dosage to obtain maximum leukaemic cell kill with tolerable toxicity, than on the fundamental treatment protocol selected at the start of therapy. Toxicity necessitating dosage modification almost always occurs.

Dosage of cytarabine must be based on the clinical and haematological response and tolerance of the patient so as to obtain optimum therapeutic results with minimum adverse effects. Even though higher total doses of cytarabine can be given by IV injection compared to continuous IV infusion with similar haematologic toxicity, the most effective dosage schedule and method of administration are yet to be established. Moreover, cytarabine is often used in combination with other cytotoxic drugs, thereby necessitating dose modification of cytarabine and other chemotherapeutic agents, and the method as well as the sequence of administration.

Following is an outline of dosage schedules for cytarabine therapy as reported in the literature.

Dosage schedules:

Single-Drug Therapy in induction remission in adults with Acute Myelocytic Leukaemia:

Cytarabine 200 milligrams/m² daily by continuous IV infusion over 24 hours for 5 days (120 hours) - total dose 1000 milligrams/m². The course is repeated approximately every 2 weeks. Modifications based on haematologic response should be made.

Cytarabine combination therapy:

Before a combined chemotherapy protocol is instituted, the clinician should be familiar with current literature, precautions, contraindications, adverse reactions and warnings applicable to all the drugs involved in the protocol.

Cytarabine, Daunorubicin

Cytarabine: 100 milligrams/m²/day, continuous IV infusion (days 1 to 7)

Daunorubicin: 45 milligrams/m²/day, IV push (days 1 to 3)

Additional courses (complete or modified) as required at 2 to 4 week intervals if leukaemia is persistent.

Cytarabine, Thioguanine, Daunorubicin

Cytarabine: 100 milligrams/m²/day, IV infusion over 30 minutes every 12 hours (days 1 to 7)

Thioguanine: 100 milligrams/m², orally every 12 hours (days 1 to 7)

Daunorubicin: 60 milligrams/m²/day, IV infusion (days 5 to 7)

Additional courses (complete or modified) as required at 2 to 4 week intervals if leukaemia is persistent.

Cytarabine, Doxorubicin

Cytarabine: 100 milligrams/m²/day, continuous IV infusion (days 1 to 10)

Doxorubicin: 30 milligrams/m²/day, IV infusion over 30 minutes (days 1 to 3)

Additional courses (complete or modified) as required at 2 to 4 week intervals if leukaemia is persistent.

Cytarabine, Doxorubicin, Vincristine, Prednisolone

Cytarabine: 100 milligrams/m²/day, continuous IV infusion (days 1 to 7)

Doxorubicin: 30 milligrams/m²/day, IV infusion (days 1 to 3)

Vincristine: 1.5 milligrams/m²/day, IV infusion (days 1, 5)

Prednisolone: 40 milligrams/m²/day, IV infusion every 12 hours (days 1 to 5)

Additional courses (complete or modified) as required at 2 to 4 week intervals if leukaemia is persistent.

Cytarabine, Daunorubicin, Thioguanine, Prednisone, Vincristine

Cytarabine: 100 milligrams/m²/day, IV every 12 hours (days 1 to 7)

Daunorubicin: 70 milligrams/m²/day, IV infusion (days 1 to 3)

Thioguanine: 100 milligrams/m² orally every 12 hours (days 1 to 7)

Prednisone: 40 milligrams/m²/day, orally (days 1 to 7)

Vincristine: 1 milligram/m²/day, IV infusion (days 1,7)

Additional courses (complete or modified) as required at 2 to 4 week intervals, if leukaemia is persistent.

Maintenance of Acute Myelocytic Leukaemia (AML) in adults:

Maintenance programs are generally modifications of induction programs. Similar schedules of drug therapy to those used for induction are normally employed. Most programs have a greater interval between courses of therapy during remission maintenance.

Induction and maintenance of Acute Myelocytic Leukaemia (AML) in children:

Childhood AML has been shown to respond better than adult AML given similar regimens. Where the adult dosage is given in terms of body weight or surface area, the paediatric dosage may be calculated on the same basis, being adjusted on the consideration of such factors as age, body weight or body surface area.

Acute Lymphocytic Leukaemia (ALL):

Dosage schedules used in ALL are normally similar to those used in AML with some modifications.

Intrathecal use in Meningeal Leukaemia:

Cytarabine has been used intrathecally in acute leukaemia in doses ranging from 5 mg/m² to 75 mg/m² of body surface area. The frequency of administration varied from once a day for 4 days to once every 4 days. The most frequently used dose was 30 mg/m² every 4 days until cerebrospinal fluid findings were normal, followed by one additional treatment. The dosage schedule is usually governed by the type and severity of central nervous system manifestations and the response to previous therapy (see **Adverse Effects**).

Dosage modification:

Suspension or modification of cytarabine therapy should be considered at the appearance of signs of serious haematologic depression, for example, if the polymorphonuclear granulocyte count falls below 1000/mm³ or the platelet count falls below 50,000/mm³. Such guidelines may be modified, depending on signs of toxicity in other systems and on the speed of fall in levels of formed blood elements. Therapy should be recommended when definite signs of bone marrow recovery appear and the above granulocyte and platelet levels are attained. If therapy is withheld until peripheral counts of blood elements return to normal, cytarabine may be ineffective.

Cytarabine Injection is a ready to use solution with a concentration of 100 milligrams per mL. It is suitable for intravenous use and in small volumes may also be used subcutaneously. Cytarabine Injection 100 milligrams per mL is hypertonic and therefore unsuitable for intrathecal use unless diluted appropriately.

Directions for use of ONCO·VIAL®

1. Remove the protective sheath from the cap along the perforations.

2. Remove the protective cap from the vial and the clear cylindrical plastic cover from the adaptor.

3. Insert the adaptor into the vial and turn the adaptor three times in a clockwise direction until you feel some resistance, then rotate another half turn.



4. Remove the cap from the adaptor, then attach an empty Luer lock syringe with the plunger fully depressed and turn the syringe clockwise until it locks.

5. Hold the assembled vial and syringe almost vertical (with the empty syringe on the bottom), then pull back the plunger of the empty syringe slowly to withdraw the desired dose.



6. Detach the syringe by turning it in an anticlockwise direction. Re cap ONCO·VIAL® if there is solution remaining.

Cytarabine Injection 100 milligrams per mL is hypertonic and unsuitable for intrathecal use.

The potency of cytarabine is retained for 24 hours at 25°C in the following IV fluids:

1. Water for Injection
2. Glucose 5% in water
3. Sodium Chloride 0.9%

4. Ringer's injection, lactated

Although stability of cytarabine is well retained for 24 hours in intravenous vehicles noted above, it is recommended that, as with all intravenous admixtures, dilution should be made just prior to administration and the resulting solution used within 24 hours.

Contraindications

Cytarabine is contraindicated in patients with known hypersensitivity to the drug.

Warnings and Precautions

Cytarabine is a potent bone marrow suppressant. Patients receiving the drug must be kept under close medical supervision. Leucocyte and platelet counts should be performed daily and frequent bone marrow examinations conducted. Facilities should be available for management of complications of bone marrow suppression.

Cytarabine Injection 100 milligrams per mL (ready prepared solution) is hypertonic and therefore is unsuitable for intrathecal use.

Two patients with childhood acute myelogenous leukaemia who received intrathecal and intravenous cytarabine at conventional doses in addition to a number of other concomitantly administered drugs, developed delayed progressive ascending paralysis resulting in death in one of the two patients.

Cytarabine should only be used under constant supervision by physicians experienced in therapy with cytotoxic agents.

Hyperuricaemia secondary to rapid lysis of neoplastic cells may occur in patients receiving cytarabine; serum uric acid concentrations should be monitored.

Periodic determinations of renal and hepatic function should also be performed.

Use the drug with caution and at reduced doses in patients whose liver function is poor as the liver apparently detoxifies a substantial fraction of an administered dose.

Acute pancreatitis has been reported to occur in patients being treated with cytarabine who have had prior treatment with L-asparaginase.

Patients treated with high dose cytarabine should be observed for neuropathy since dose schedule alteration may be needed to avoid irreversible neurological disorders.

Use in Children

Appropriate studies with cytarabine have not been performed in the paediatric population. However, paediatric-specific problems that would limit the usefulness of this medication in children are not expected.

Use in the Elderly

Although studies with cytarabine have not been performed in the geriatric population, geriatric-specific problems that would limit the usefulness of this medication in the elderly are not expected. Elderly patients are, however, more likely to have age-related renal function impairment, which may require reduction of dosage in patients receiving cytarabine.

Mutagenicity

Cytarabine may cause chromosomal damage, including chromatoid breaks, in humans. Malignant transformation of rodent cells in culture has been reported.

Carcinogenicity

Secondary malignancies are potential delayed effects of many antineoplastic agents, although it is not clear whether the effect is related to their mutagenic or immunosuppressive action. The effect of dose and duration of therapy is also unknown, although risk seems to increase with long-term use.

Antimetabolites have been shown to be carcinogenic in animals and may be associated with an increased risk of development of secondary carcinomas in humans.

Pregnancy and Lactation

Use in pregnancy. Cytarabine is suspected to have caused or may be expected to cause an increased incidence of human fetal malformations or irreversible damage. It may also have adverse pharmacological effects. Cytarabine has been shown to be teratogenic in some animal species and should not be used during pregnancy, especially during the first trimester, nor in women likely to become pregnant.

Use in lactation It is not known whether cytarabine is excreted in human milk. Women should be advised not to breast feed while being treated with cytarabine, because of the risks to the infant (see Adverse Effects, Mutagenicity, Carcinogenicity).

Effects on ability to drive and use machines.

Cytarabine for Injection is likely to produce severe adverse effects, which may impair the patient's ability to concentrate and react and therefore constitute a risk in the ability to drive and use machines.

Adverse effects

The major adverse effect of cytarabine is haematologic toxicity. Myelosuppression is normally manifested by megaloblastosis, leucopenia, anaemia, reticulocytopenia and thrombocytopenia. Leucopenia follows mainly from granulocyte depression; lymphocytes are minimally affected. The severity of these adverse effects is dependent on the dose of the drug and schedule of administration.

Granulocytopenia is biphasic, with a nadir at 7 to 9 days after a dose and another, more severe, at 15 to 24 days. The nadir of the platelet count occurs at about 12 to 15 days. Recovery generally occurs in a further ten days.

The incidence and severity of haematologic toxicity is minimal after a single intravenous dose of cytarabine, but myelosuppression occurs in almost all patients with daily IV injections or continuous IV infusions of the drug.

Nausea and vomiting may occur in patients on cytarabine therapy, and usually occur more frequently and severely following rapid IV administration as opposed to continuous infusion of the drug.

Other adverse effects of the GI tract include anorexia, diarrhoea, and oral and anal inflammation or ulceration. Abdominal pain, oesophagitis, sore throat, oesophageal ulceration, and GI haemorrhage occur less frequently. In one study, cytarabine has been reported to induce severe intestinal toxicity when used in several sequential chemotherapeutic protocols. The mucosal alterations induced were characterised by surface and glandular epithelial atypia, immaturity and necrosis. These were associated with diarrhoea, ileus, abdominal pain, haematemesis and melaena, severe hypokalaemia, hypocalcaemia, a protein-losing enteropathy, transient weight gains and intestinal infections.

Viral, bacterial, fungal parasitic or saprophytic infection which can be mild, severe and at times fatal, may be associated with the use of cytarabine when used alone or in combination with other immunosuppressive agents following immunosuppressive doses that affect cellular or humoral immunity.

Hepatic dysfunction, characterised by jaundice, elevations in serum bilirubin, transaminases, and alkaline phosphatases, have occurred in patients receiving cytarabine alone or with other antineoplastic agents, but a causal relationship has not been definitely established.

Although systemic toxicity infrequently occurs with intrathecal administration of cytarabine, the haematologic status of the patient must be carefully monitored. Modification of the anti-leukaemic therapy may be required. The most frequently encountered adverse effects of intrathecal cytarabine are nausea, vomiting, transient headaches and fever, but these reactions are mild and self-limiting. Paraplegia has been reported.

Neurotoxicity following intrathecal cytarabine has been associated with preservative-containing diluents and many clinicians recommend the use of preservative-free diluents instead.

Blindness occurred in 2 patients with ALL during remission, who had received systemic combination therapy, prophylactic CNS radiation as well as intrathecal cytarabine. Necrotizing leucoencephalopathy

has been reported to have occurred in 5 children who had received triple intrathecal therapy consisting of cytarabine, methotrexate and hydrocortisone, and CNS irradiation.

Other reported adverse effects of cytarabine include fever, rash, conjunctivitis (may occur with rash), alopecia, freckling, skin ulceration, urinary retention, renal dysfunction, chest pain, dizziness, somnolence, neuritis or neural toxicity and reactions at the site of injection such as pain, inflammation, thrombophlebitis, or cellulitis.

One patient suffered anaphylaxis with acute cardiopulmonary arrest which required resuscitation, immediately following IV administration of the drug.

A cytarabine syndrome characterised by fever, myalgia, bone pain, malaise, maculopapular rash, conjunctivitis, and occasionally chest pain, has been reported. A "flu-like" syndrome has been reported, which may be treated with corticosteroid therapy if severe. Anaphylactoid reactions have occurred. It normally occurs at 6 to 12 hours after administration of the drug; corticosteroids have been shown to be of benefit in the treatment and prevention of the syndrome. If treatment of the symptoms of the syndrome is required, administration of corticosteroids should be considered, as well as continuation of cytarabine therapy.

As a consequence of extensive purine catabolism accompanying rapid cellular destruction, hyperuricaemia may occur in patients on cytarabine therapy; serum uric acid levels should be monitored. Hyperuricaemia may be minimised by adequate hydration, alkalinization of the urine, and/or administration of allopurinol.

Although doses exceeding recommended dosage schedules have been used clinically and have been tolerated, severe and at times fatal adverse effects have been associated with high-dose cytarabine regimens (2.0 g to 3.0 g/m² given every 12 hours for 12 doses). These include cerebral and cerebellar dysfunction including personality changes, somnolence and coma which is generally reversible; conjunctivitis and reversible corneal toxicity (keratitis) consisting of ocular pain, tearing, foreign-body sensation, photophobia and blurred vision; pulmonary oedema and severe GI ulceration including pneumatosis cystoides intestinalis leading to peritonitis, sepsis and liver abscess; liver changes, necrotising colitis and bowel necrosis. Severe skin rash leading to desquamation, alopecia and cardiac disorders has also been reported.

Doses of 4.5 g/m² IV infusion over 1 hour every 12 hours for 12 doses have caused an unacceptable increase in irreversible toxicity and even death.

Two patients with adult nonlymphocytic leukaemia developed peripheral motor and sensory neuropathies after consolidation with high dose cytarabine, daunorubicin and asparaginase.

A syndrome of sudden respiratory distress, rapidly progressing to pulmonary oedema and radiologically pronounced cardiomegaly has been reported following experimental high dose therapy of cytarabine for relapsed leukaemia. This syndrome can have fatal consequences.

Interactions

The incidence and severity of haematologic toxicity induced by cytarabine is exacerbated when other myelosuppressive drugs are given concurrently.

Use with care following prior treatment with L-asparaginase (see **Warnings and Precautions**)

- *Flucytosine* should not be administered concomitantly with cytarabine. Cytarabine has been reported to antagonise the antifungal activity of flucytosine by competitive inhibition.
- *Allopurinol, Colchicine, Probenecid or Sulphinpyrazone*: Cytarabine may raise the concentration of blood uric acid. Dosage adjustment of antigout agents may be necessary to control hyperuricaemia and gout. Allopurinol may be preferred to prevent or reverse cytarabine-induced hyperuricaemia because of risk of uric acid nephropathy with uricosuric antigout agents.
- *Blood Dyscrasia Causing Medications*: Leukopenic and/or thrombocytopenic effects of cytarabine may be increased with concurrent or recent therapy if these medications cause the same effects, dosage adjustment of cytarabine, if necessary, should be based on blood counts.

- *Bone Marrow Depressants or Radiation Therapy*: Additive bone marrow depression may occur; dosage reduction may be required when two or more bone marrow depressants, including radiation, are used concurrently or consecutively.
- *Cyclophosphamide*: Concurrent use with high-dose cytarabine therapy for bone marrow transplant preparation has been reported to result in an increase in cardiomyopathy with subsequent death.
- *Methotrexate*: Cytarabine has been reported to inhibit the cellular uptake of methotrexate, thus reducing its effectiveness. Conversely, methotrexate has been reported to decrease the intracellular activation of cytarabine. These factors should be considered when using the medicines concurrently.

Overdosage

Severe bone marrow depression, gastrointestinal toxicity and vomiting are among the signs and symptoms expected. Treatment with cytarabine should be ceased and supportive measures instituted. In bone marrow depression, transfusions of blood products may be required and active measures may be necessary to combat infection.

Hyperuricaemia is avoided by the addition of allopurinol to treatment schedules and measures such as alkalinisation of the urine and hydration may also be adopted.

Techniques attempting to prevent the occurrence of alopecia have met with varying success. Scalp tourniquets and ice packs have been used to minimize concentrations of antineoplastic agents in the scalp after intravenous injection. Such methods, however, may allow the development of a cancer-cell sanctuary and should not be used in patients with leukaemia or other conditions with circulating malignant cells.

The treatment of extravasation is controversial. Warm moist soaks or ice packs have been applied and a corticosteroid may sometimes be instilled into the affected area.

Antiemetic therapy should be given in an attempt to prevent or control nausea and vomiting.

Pharmaceutical precautions

Incompatibilities

No information available.

Special Precautions for Storage

Store below 25°C. Protect from light.

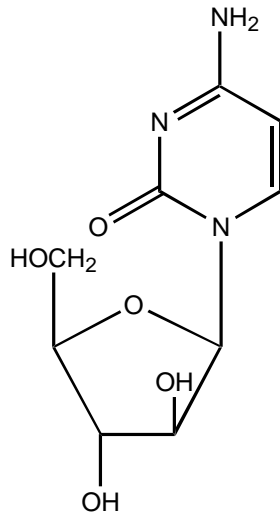
Medicine classification

Prescription Medicine.

Further information

The CAS registry number of cytarabine is 147-94-4.

The structural formula of cytarabine is shown below:

**Package quantities**

Cytarabine Solution for Injection is presented in vials containing cytarabine as a sterile solution:

Strength	Pack Size
20 milligrams per 1mL	1 vial per pack
50 milligrams per 1mL	1 vial per pack
100 milligrams per 1mL	1 vial per pack

Name and address

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Date of preparation

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