AUSTRALIAN PRODUCT INFORMATION – FLUDARA ORAL (FLUDARABINE PHOSPHATE) TABLETS

1 NAME OF THE MEDICINE

Fludarabine phosphate

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Fludara Oral contains fludarabine phosphate, a fluorinated nucleotide analogue of the antiviral agent vidarabine, (9-β-D-arabinofuranosyladenine) that is relatively resistant to deamination by adenosine deaminase.

Each Fludara Oral tablet contains 10 mg of fludarabine phosphate.

Excipients with known effect: sugars as lactose. For the full list of excipients, see Section 6.1, List of Excipients.

3 PHARMACEUTICAL FORM

Film coated tablets (salmon coloured oval shaped tablets with "LN" indented in a regular hexagon on one side).

4 CLINICAL PARTICULARS

4.1 THERAPEUTIC INDICATIONS

Fludara Oral is indicated for the treatment of B - cell chronic lymphocytic leukaemia.

4.2 DOSE AND METHOD OF ADMINISTRATION

Adults

Fludara Oral tablets should be prescribed by a qualified physician experienced in the use of antineoplastic therapy.

The recommended dose is 40 mg fludarabine phosphate/m^2 body surface given daily for 5 consecutive days every 28 days by the oral route. Fludara Oral tablets can be taken either on an empty stomach or together with food. The tablets are to be swallowed whole with water, and must not be chewed or broken.

The duration of treatment depends on the treatment success and the tolerability of the drug. Fludara Oral should be administered up to achievement of best response (complete or partial remission, usually 6 cycles) and then the drug should be discontinued.

Toxicity

Dosage may be decreased or delayed based on evidence of haematological and non haematological toxicity. Physicians should consider delaying or discontinuing the drug if toxicity occurs.

Impaired State of Health

A number of clinical settings may predispose to increased toxicity from Fludara Oral. These include advanced age, renal insufficiency and bone marrow impairment (refer to Section 4.4.6 Use in specialised groups). Such patients should be monitored closely for excessive toxicity and the dose modified accordingly.

Impaired renal function

Dosage reduction is required in renally impaired patients. Refer to Section 4.4.6, Use in specialised groups and Section 5.2.5, Special Populations of this document.

Retreatment options after initial Fludara Oral treatment

Patients who primarily respond to Fludara Oral have a good chance of responding again to Fludara Oral monotherapy. A crossover from initial treatment with Fludara Oral to chlorambucil for non responders to Fludara Oral should be avoided. In a clinical trial, 46 subjects who failed initial fludarabine therapy were treated with chlorambucil 40 mg/m^2 every 28 days. Only one subject (2 %) achieved a partial response.

4.3 CONTRAINDICATIONS

- Hypersensitivity to the active substance or to any of the excipients
- Renal impairment with creatinine clearance < 30 mL / min
- Hemolytic anemia

Fludara Oral is contraindicated during pregnancy and lactation.

4.4 SPECIAL WARNINGS AND PRECAUTIONS FOR USE

Neurotoxicity

When used at high doses in dose - ranging studies in patients with acute leukaemia, Fludara Oral was associated with severe neurologic effects, including blindness, coma and death. Symptoms

appeared from 21 to 60 days from last dose. This severe central nervous system toxicity occurred in 36% of patients treated intravenously with doses approximately four times greater (96mg/m^2/day for 5 - 7 days) than the dose recommended for treatment of CLL.

Similar severe central nervous system toxicity has also been observed in patients treated at doses recommended for CLL. Confusion occurred uncommonly and coma, seizures and agitation rarely (see Section 4.8, Adverse Effects (Undesirable Effects)).

In postmarketing experience, neurotoxicity has also been reported to occur with a latency ranging from 7 to 225 days after the last dose of Fludara Oral.

The effect of chronic administration of Fludara Oral on the central nervous system is unknown. However, patients tolerated the recommended dose, in some studies for relatively long treatment times (for up to 26 courses of therapy). Patients should be closely observed for signs of neurologic side effects.

Administration of Fludara Oral can be associated with leukoencephalopathy (LE), acute toxic leukoencephalopathy (ATL) or reversible posterior leukoencephalopathy syndrome (RPLS).

These may occur:

- at the recommended dose
    - when Fludara Oral is given following, or in combination with, medications known to be associated with LE, ATL or RPLS,
    - when Fludara Oral is given to patients with other risk factors such as previous exposure to cranial or total body irradiation, Hematopoietic Cell Transplantation, Graft versus Host Disease, renal impairment, or hepatic encephalopathy.
- at doses higher than the recommended dose

LE, ATL or RPLS symptoms may include headache, nausea and vomiting, seizures, visual disturbances such as vision loss, altered sensorium, and focal neurological deficits. Additional effects may include optic neuritis, and papillitis, confusion, somnolence, agitation, paraparesis/ quadriparesis, muscle spasticity and incontinence. LE/ ATL/ RPLS may be irreversible, life-threatening, or fatal.

Whenever LE, ATL or RPLS is suspected, fludarabine treatment should be stopped. Patients should be monitored and should undergo brain imaging, preferably utilizing MRI. If the diagnosis is confirmed, fludarabine therapy should be permanently discontinued. Treating physicians should diagnose and monitor the patient with appropriate techniques (ideally brain imaging, MRI etc).

Myelosuppression

Severe bone marrow suppression, notably anaemia, thrombocytopenia and neutropenia, has been reported in patients treated with Fludara Oral. In a Phase I study in solid tumour patients, the median time to nadir counts was 13 days (range, 3 - 25 days) for granulocytes and 16 days (range, 2 - 32) for platelets. Most patients had haematologic impairment at baseline either as a result of

disease or as a result of prior myelosuppressive therapy. Cumulative myelosuppression may be seen. While chemotherapy-induced myelosuppression is often reversible, administration of fludarabine phosphate requires careful haematological monitoring.

Fludara Oral is a potent antineoplastic agent with potentially significant toxic side effects. Patients undergoing therapy should be closely observed for signs of haematologic and non - haematologic toxicity. Periodic assessment of peripheral blood counts is recommended to detect the development of anaemia, neutropenia and thrombocytopenia. In such cases, as a general rule, the dose of myelosuppressive agents should be reduced or the dosage interval extended.

Several instances of trilineage bone marrow hypoplasia or aplasia resulting in pancytopenia, sometimes resulting in death, have been reported in adult patients. The duration of clinically significant cytopenia in the reported cases has ranged from approximately 2 months to 1 year. These episodes have occurred both in previously treated or untreated patients.

Disease progression

Disease progression and transformation (e.g. Richter's syndrome) have been commonly reported in CLL patients.

Tumour lysis syndrome

Tumour lysis syndrome associated with Fludara Oral treatment has been reported in CLL patients with large tumour burdens. Since Fludara Oral can induce a response as early as the first week of treatment, precautions should be taken in those patients at risk of developing this complication.

Autoimmune phenomena

Irrespective of any previous history of autoimmune processes or Coombs test status, life threatening and sometimes fatal autoimmune phenomena (e.g. autoimmune haemolytic anaemia, autoimmune thrombocytopenia, thrombocytopenic purpura, pemphigus, Evans' syndrome) have been reported to occur during or after treatment with Fludara Oral. The majority of patients experiencing haemolytic anaemia developed a recurrence in the haemolytic process after rechallenge with Fludara Oral.

Patients undergoing treatment with Fludara Oral should be closely monitored for signs of haemolysis. Discontinuation of therapy with Fludara Oral is recommended in case of haemolysis. Blood transfusion (irradiated) and adrenocorticoid preparations are the most common treatment measures for autoimmune haemolytic anaemia.

Use in specialised groups

Impaired state of health

Patients who have advanced stage disease, hypoalbuminaemia, reduced platelet count or haemoglobin levels, white cell count above 50 x 109 / L, significant hepatic or spleen

enlargement, extensive prior therapy or poor performance status are at risk of serious and sometimes fatal toxicity during the first 6 months of treatment.

Fludarabine treatment may be associated with a spectrum of infections different from those seen with neutropenia from standard chemotherapy drugs. Prophylactic treatment should be considered in patients at increased risk of developing opportunistic infections, which include, but are not limited to, pneumocytis, fungi and herpes virus infections.

The dose of 25 mg/m^2/day for 5 days by intravenous infusion may be greater than needed in some patients, especially those at risk and consideration should be given to using a lower dose in such patients.

Use in renal impairment

There are limited data in dosing of patients with renal insufficiency. Careful monitoring for haematological toxicity is required and possible dose reductions of Fludara Oral in patients with renal impairment and patients with depressed white cell count and platelet counts or patients with infection or bleeding, may be required.

The total body clearance of 2-fluoro-ara-A shows a correlation with creatinine clearance, indicating the importance of the renal excretion pathway for the elimination of the compound. Patients with reduced renal function demonstrated an increased total body exposure (AUC of 2F-ara-A). Limited clinical data are available in patients with impairment of renal function (creatinine clearance below 70mL / min). Fludara Oral must be administered cautiously in patients with renal insufficiency. In patients with moderate impairment of renal function (creatinine clearance between 30 and 70mL / min), the dose should be reduced in proportion to the reduced creatinine clearance and close haematological monitoring should be used to assess toxicity. Fludara Oral treatment is contraindicated, if creatinine clearance is < 30mL / min.

Use in hepatic impairment

No data are available concerning the use of Fludara Oral in patients with hepatic impairment. In this group of patients, Fludara Oral should be used with caution, and administered if the potential benefit outweighs any potential risk.

Use in the elderly

Since there are limited data for the use of Fludara Oral in elderly persons (> 75 years), caution should be exercised with the administration of Fludara Oral in these patients.

Pediatric use

Fludara Oral is not recommended for the use in children below age 18 due to a lack of data on safety and efficacy.

Effects on laboratory tests

No data available

Vaccination

During and after treatment with Fludara Oral vaccination with live vaccines should be avoided.

4.5 INTERACTIONS WITH OTHER MEDICINES AND OTHER FORMS OF INTERACTIONS

In a clinical investigation using Fludara Oral in combination with pentostatin (deoxycoformycin) for the treatment of refractory chronic lymphocytic leukaemia (CLL), there was an unacceptably high incidence of fatal pulmonary toxicity. Therefore, the use of Fludara Oral in combination with pentostatin is not recommended.

A pharmacokinetic drug interaction was observed in AML patients during combination therapy with fludarabine phosphate and Ara-C. Clinical studies and *in vitro* experiments with cancer cell lines demonstrated elevated intracellular Ara-CTP levels in combination with Fludara Oral treatment.

Dipyrimadole and other inhibitors of adenosine uptake may reduce the therapeutic efficacy of Fludara Oral.

In clinical investigation, pharmacokinetic parameters after peroral administration were not significantly affected by concomitant food intake.

4.6 FERTILITY, PREGNANCY AND LACTATION

Effects on Fertility

Due to the genotoxic risk of fludarabine phosphate females of childbearing potential must be apprised of the potential hazard to the foetus.

Females of childbearing potential must take effective contraceptive measures during and at least for 6 months after cessation of therapy. Male patients must use effective methods of contraception and be advised to not father a child while receiving Fludara Oral, and following completion of treatment. Prior to Fludara Oral treatment, patients must seek advice on fertility preservation options. After Fludara Oral treatment, patients planning pregnancy are advised to seek genetic counselling.

Studies in mice, rats and dogs have demonstrated dose-related adverse effects on the male reproductive system. Observations consisted of a decrease in mean testicular weights in dogs and degeneration and necrosis of spermatogenic epithelium of the testes in mice, rats and dogs. These results indicate that fludarabine phosphate may adversely affect male fertility, but this has not been directly investigated in studies of reproductive function. No information is available from

animal studies on potential effects on female fertility. The possible adverse effects on fertility in humans have not been adequately evaluated.

Use in pregnancy

Category D

Fludara Oral should not be used during pregnancy. There are very limited data of Fludara Oral use in pregnant women in the first trimester. One case of fludarabine phosphate use during early pregnancy leading to skeletal and cardiac malformation in the newborn has been reported. Early pregnancy loss has been reported in Fludara Oral monotherapy as well as in combination therapy. Premature delivery has been reported.

Fludarabine phosphate has been shown to be genotoxic. Fludarabine phosphate has also been shown to be embryotoxic, fetotoxic and teratogenic in animal studies. Preclinical data in rats demonstrated a transfer of fludarabine phosphate and /or metabolites through the feto - placental barrier. In view of the small exposure margin between teratogenic doses in animals and the human therapeutic dose as well as in analogy to other antimetabolites which are assumed to interfere with the process of differentiation, the therapeutic use of Fludara Oral is associated with a relevant risk of teratogenic effects in humans.

Fludara Oral may cause foetal harm when administered to pregnant females. Therefore, Fludara Oral must not be used during pregnancy.

Females of childbearing potential receiving Fludara Oral should be advised to avoid becoming pregnant, and to inform the treating physician immediately should this occur.

Due to the genotoxic risk of fludarabine phosphate, females of childbearing potential or fertile males must take contraceptive measures during and at least for 6 months after cessation of therapy. If the patient becomes pregnant while taking this drug, the patient should be advised of the potential hazard to the foetus.

Use in Lactation

It is not known whether fludarabine phosphate is excreted in human milk. However there is evidence from preclinical data that fludarabine phosphate and / or metabolites transfer from maternal blood to milk. Because of the potential for adverse reactions in nursing infants from Fludara Oral, breast feeding must be discontinued for the duration of Fludara Oral therapy.

Breastfeeding should not be initiated during Fludara Oral treatment.

4.7 EFFECTS ON ABILITY TO DRIVE AND USE MACHINES

Fludara Oral may reduce the ability to drive or use machines, since fatigue, weakness, visual disturbances, confusion, agitation and seizures have been observed. Patients experiencing such adverse effects should avoid driving and using machines.

4.8 ADVERSE EFFECTS (UNDESIRABLE EFFECTS)

Based on the experience with the intravenous use of Fludara Oral, the most common adverse events include myelosuppression (neutropenia, thrombocytopenia and anaemia), infection including pneumonia, cough, fever, fatigue, weakness, nausea, vomiting and diarrhoea.

Other commonly reported events include chills, oedema, malaise, anorexia, peripheral neuropathy, visual disturbances, stomatitis, skin rashes, and mucositis. Serious opportunistic infections have occurred in CLL patients treated with Fludara Oral. Fatalities as a consequence of serious adverse events have been reported.

The table below reports adverse events by MedDRA system organ classes (MedDRA SOCs). The frequencies are based on clinical trial data regardless of the causal relationship with Fludara Oral. The rare adverse reactions were mainly identified from post marketing experience.

Table 1 - Adverse events reported in clinical trials or during post-marketing surveillance in patients treated with Fludara Oral

System Organ Class **MedDRA**	**Very Common** **≥1/10**	**Common** **≥ 1/100 to <1/10**	**Uncommon** **≥ 1/1000 to <1/100**	**Rare** **≥1/10,000 to <1/1000**
Infections and infestations	Infections / Opportunistic infections (like latent viral reactivation, e.g. Herpes zoster virus Epstein-Barr-virus Progressive multifocal leucoencephalopathy), Pneumonia			Lympho-proliferative disorder (EBV-associated)

System Organ Class MedDRA	Very Common ≥1/10	Common ≥ 1/100 to <1/10	Uncommon ≥ 1/1000 to <1/100	Rare ≥1/10,000 to <1/1000
Neoplasms benign, malignant and unspecified (incl cysts and polyps)		Myelodysplastic syndrome and Acute myeloid leukaemia (mainly associated with prior, concomitant or subsequent treatment with alkylating agents, topoisomerase inhibitors or irradiation)		
Blood and lymphatic system disorders	Neutropenia, Anemia, Thrombocytopenia	Myelosuppression		
Immune system disorders			Autoimmune disorder (including Autoimmune haemolytic anaemia, Thrombocytopenic purpura, Pemphigus, Evans syndrome, Acquired haemophilia)	
Metabolism and nutrition disorders		Anorexia	Tumor lysis syndrome (including Renal failure, Hyperkalemia, Metabolic acidosis, Haematuria, Urate crystalluria, Hyperuricaemia, Hyperphosphataemia, Hypocalcaemia)	
Nervous system disorders		Neuropathy peripheral	Confusion	Agitation, Seizures Coma

System Organ Class MedDRA	Very Common ≥1/10	Common ≥ 1/100 to <1/10	Uncommon ≥ 1/1000 to <1/100	Rare ≥1/10,000 to <1/1000
Eye disorders		Visual disturbance		Optic neuritis, Optic neuropathy, Blindness
Cardiac disorders				Heart failure, Arrhythmia
Vascular disorders			Gastrointestinal haemorrhage	
Respiratory, thoracic and mediastinal disorders	Cough		Pulmonary toxicity (including Dyspnoea, Pulmonary fibrosis, Pneumonitis)	
Gastrointestinal disorders	Nausea, Vomiting, Diarrhoea	Stomatitis	Pancreatic enzymes abnormal	
Hepatobiliary disorders			Hepatic enzyme abnormal	
Skin and subcutaneous tissue disorders		Rash		Skin cancer, Stevens-Johnson syndrome, Necrolysis epidermal toxic (Lyell type)
General disorders and administration site conditions	Fever, Fatigue, Weakness	Chills, Malaise, Oedema, Mucositis		

Postmarketing Experience

Postmarketing experience with unknown frequency

- Nervous system disorders
  - Leukoencephalopathy (see Section 4.4, Special Warnings and Precautions for Use)
  - Acute toxic leukoencephalopathy (see Section 4.4, Special Warnings and Precautions for Use)
  - Reversible posterior leukoencephalopathy syndrome (RPLS) (see Section 4.4, Special Warnings and Precautions for Use)
- Vascular disorders
  - Haemorrhage (including cerebral hemorrhage, pulmonary haemorrhage, haemorrhagic cystitis)

Reporting Suspected Adverse Reactions

Reporting suspected adverse reactions after registration of the medicinal product is important. It allows continued monitoring of the benefit-risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions at www.tga.gov.au/reporting-problems.

4.9 OVERDOSE

High doses of Fludara Oral have been associated with leukoencephalopathy, acute toxic leukoencephalopathy, reversible posterior leukoencephalopathy syndrome (RPLS). Symptoms may include headache, nausea and vomiting, seizures, visual disturbances such as vision loss, altered sensorium, and focal neurological deficits. Additional effects may include optic neuritis, and papillitis, confusion, somnolence, agitation, paraparesis/ quadriparesis, muscle spasticity, incontinence, irreversible central nervous system toxicity characterised by delayed blindness, coma, and death. High doses are also associated with severe thrombocytopenia and neutropenia due to bone marrow suppression. There is no known specific antidote for Fludara Oral overdosage. Treatment consists of drug discontinuation and supportive therapy.

For information on the management of overdose, contact the Poisons Information Centre on 131126 (Australia).

5 PHARMACOLOGICAL PROPERTIES

5.1 PHARMACODYNAMICS PROPERTIES

Pharmacotherapeutic group: Antineoplastic agents, purine analogues; ATC code: L01B B05

Mechanism of Action

Fludarabine phosphate is rapidly dephosphorylated to fludarabine (2F-ara-A) which is taken up by cells and then phosphorylated intracellularly by deoxycytidine kinase to the active triphosphate, fludarabine triphosphate (2F-ara-ATP). This metabolite has been shown to inhibit ribonucleotide reductase, DNA polymerase α,δ and ε, DNA primase and DNA ligase thereby inhibiting DNA synthesis. Furthermore, partial inhibition of RNA polymerase II and consequent reduction in protein synthesis occurs.

Whilst some aspects of the mechanism of action of fludarabine triphosphate are as yet unclear, it is assumed that effects on DNA, RNA and protein synthesis all contribute to inhibition of cell growth with inhibition of DNA synthesis being the dominant factor. In addition, *in vitro* studies have shown that exposure of chronic lymphocytic leukaemia (CLL) lymphocytes to fludarabine (2F-ara-A) triggers extensive DNA fragmentation and cell death characteristic of apoptosis. Fludarabine phosphate has also been shown to trigger these changes in normal (non - malignant) lymphoid cells.

Clinical Trials

The following information refers to the use of Fludara Oral in 1st line chronic lymphocytic leukaemia.

Intravenous fludarabine 25mg/m^2 on days 1 - 5 of a 28 day cycle significantly delayed disease progression compared with comparators in the first line treatment of B - cell CLL in three randomised controlled trials (Tables 1 - 3). A difference in survival was not shown due to insufficient follow up and confounding as a result of cross overs. There was a median 7 and maximum 21 treatment cycles.

Table 2 - IV FLUDARABINE – TRIAL 1 (Spirano) – median duration 8 cycles vs chlorambucil 30mg/m^2 orally on days 1, 15 plus methylprednisolone 40mg/m^2 intramuscularly on days 1 to 5 and 15 to 19 every 28 days (C/MP)

Fludarabine n=75	C/MP n=75	Difference (95% CI)
Complete response rate[1] %	25 21	4 (-10, 18)
Median time to progression mths	26 21	Hazard ratio = 0.53 (0.35,0.79)
Median survival mths	>48	>48

[1] US National Cancer Institute Working Group 1988 (NCI) criteria.

Table 3 - V FLUDARABINE – TRIAL 2 (Inveresk) – duration 6 cycles vs cyclophosphamide monohydrate 750mg/m^2 IV on day 1 plus doxorubicin 50mg/m^2 IV on day 1 plus prednisone 40mg/m^2 orally on days 1 - 5 every 28 days (CAP)

Fludarabine n=53	CAP n=52	Difference (95% CI)
Complete response rate[1] %	17 8	9 (6,28)
Median time to progression mths	41 17	Hazard ratio = 0.46 (0.30,0.71)
Median survival mths	65	53

[1] International Workshop on CLL criteria 1989 (IWCLL) criteria.

Table 4 - IV FLUDARABINE – TRIAL 3 (CALGB) – median duration 7 cycles vs chlorambucil 40mg/m^2 orally on day 1 every 28 days

Fludarabine n=175	Chlorambucil n=178	Difference (95% CI)
Complete response rate[1] %	15 3	12 (4,19)
Median time to progression mths	17 13	Hazard ratio = 0.55 (0.39,0.76)
Median survival mths	56 55	4

[1] Modified US National Cancer Institute Working Group 1988 criteria

Fludarabine tablets were assessed in an uncontrolled trial in 81 patients for first line treatment of B - cell CLL. The dose was 40mg/m^2 on days 1 - 5 of each 28 day treatment cycle for a mean of 6 cycles. Fewer patients in this trial had Rai stage III / IV disease (22%) than in the intravenous fludarabine trials (35 - 50%). The median time to disease progression had not been reached at the time of the analysis, but exceeded 38 months, which is comparable or better than the result in the intravenous trials. The NCI complete response rate was 12% and overall response rate 80%. In a subgroup analysis, patients with Rai stage III or IV disease had a response rate of 61% which is comparable to that observed in this subgroup in the IV studies. There were no data on survival.

5.2 PHARMACOKINETIC PROPERTIES

Absorption

The pharmacokinetics of fludarabine (2F-ara-A) has been studied after intravenous administration by rapid bolus injection, short term infusion and following continuous infusion as well as after peroral dosing of fludarabine phosphate (2F-ara-AMP).

No clear correlation was found between fludarabine pharmacokinetics and treatment efficacy in cancer patients. However, occurrence of neutropenia and haematocrit changes indicated that the cytotoxicity of fludarabine phosphate depresses haematopoiesis in a dose dependent manner.

Distribution

Fludarabine phosphate (2F-ara-AMP) is a water soluble prodrug of fludarabine (2F-ara-A), which is rapidly and quantitatively dephosphorylated in humans to the nucleoside fludarabine.

After single dose infusion of 25 mg fludarabine phosphate per m^2 to CLL patients for 30 minutes, fludarabine (2F-ara-A) reached mean maximum concentrations in the plasma of 3.5 - 3.7μM at the end of the infusion. Corresponding fludarabine (2F-ara-A) levels after the fifth dose showed a moderate accumulation with mean maximum levels of 4.4 - 4.8 μM at the end of infusion. During a 5 day treatment schedule, fludarabine (2F-ara-A) plasma trough levels increased by a factor of about 2. An accumulation of fludarabine (2F-ara-A) over several treatment cycles can be excluded. Post maximum levels decayed in three disposition phases with an initial half life of approximately 5 minutes, an intermediate half life of 1-2 hours and a terminal half life of approximately 20 hours.

Metabolism

An interstudy comparison of fludarabine (2F-ara-A) pharmacokinetics resulted in a mean total plasma clearance (CL) of 79 mL/min/m^2 (2.2 mL/min/kg) and a mean volume of distribution (Vss) of 83 L/m^2 (2.4 L/kg). Data showed a high interindividual variability. After i.v. and peroral administration of fludarabine phosphate tablets in doses of 50 – 90mg, the plasma concentration of fludarabine phosphate and the area under the plasma concentration time curve increased linearly with the dose. Additionally, after i.v administration half lives, plasma clearance and volumes of distribution remained constant independent of the dose indicating a dose linear behaviour.

After peroral fludarabine phosphate (2F-ara-AMP) doses, maximum fludarabine (2F-ara-A) plasma levels reached approximately 20 - 30% of corresponding i.v. levels at the end of infusion and occurred 1 - 2 hours post dose. The mean systemic fludarabine (2F-ara-A) availability was in the range of 50 - 65% following single and repeated doses and was similar after ingestion of a solution or immediate release tablet formulation.

After peroral dosing of fludarabine phosphate (2F-ara-AMP) with concomitant food intake a slight increase (<10%) of systemic availability (AUC), a slight decrease of maximum plasma levels (Cmax) of fludarabine (2F-ara-A) and a delayed time of occurrence of Cmax was observed. Terminal half lives were unaffected. *In vitro* investigations with human plasma proteins revealed no pronounced tendency of fludarabine (2F-ara-A) protein binding.

Excretion

Fludarabine (2F-ara-A) elimination is largely by renal excretion. 40-60% of the administered i.v. dose was excreted in the urine. Mass balance studies in laboratory animals with 3H-2F-ara-AMP showed a complete recovery of radiolabelled substances in the urine.

Special Populations

Cellular pharmacokinetics of fludarabine triphosphate

Fludarabine (2F-ara-A) is actively transported into leukaemic cells, whereupon it is rephosphorylated to the monophosphate and subsequently to the di - and triphosphate. The triphosphate 2F-ara-ATP, is the major intracellular metabolite and the only metabolite known to have cytotoxic activity. Maximum 2F-ara-ATP levels in leukemic lymphocytes of CLL patients were observed at a median of 4 hours and exhibited a considerable variation with a median peak concentration of approximately 20μM. 2F-ara-ATP levels in leukemic cells were always considerably higher than maximum 2F-ara-A levels in the plasma indicating an accumulation at the target sites. In-vitro incubation of leukemic lymphocytes showed a linear relationship between extracellular 2F-ara-A exposure (product of 2F-ara-A concentration and duration of incubation) and intracellular 2F-ara-ATP enrichment. 2F-ara-ATP elimination from target cells showed median half life values of 15 and 23 hours.

Renal Impairment

Individuals with impaired renal function exhibited a reduced total body clearance, indicating the need for a dose reduction. Three groups of CLL/non - Hodgkin's lymphoma patients with differing creatinine clearance,>70(n=10), 30 –70(n=9), <30 (n=2) mL / min, were compared. After a single dose of 25mg fludarabine by 30 minute IV infusion, AUC increased 16%in the second group and 116% in the third group relative to the first group. Multiple adjusted IV doses were then given over 5 days. The first group received 25mg/m^2/day, the second 20mg/m^2/day and the third 15mg/m^2/day. AUC was equivalent in the first and second groups, but increased 41% in the third group. [Note - Fludarabine is not recommended for patients in the third group (see Section 4.3, Contraindications).] There was a statistically significant inverse correlation between fludarabine AUC and creatinine clearance.

5.3 PRECLINICAL SAFETY DATA

Carcinogenicity

No animal carcinogenicity studies with Fludara Oral have been conducted. However, positive findings in carcinogenicity studies with other cytotoxic drugs and the positive genotoxicity findings with fludarabine phosphate suggest that Fludara Oral has carcinogenic potential.

Genotoxicity

Fludarabine phosphate has been shown not to cause gene mutations in bacterial and mammalian cells *in vitro*. Chromosomal aberrations were observed in an *in vitro* assay using Chinese hamster ovary (CHO) cells under metabolically activated conditions. Fludarabine phosphate has also been shown to be clastogenic in the *in vivo* mouse micronucleus test. In addition, fludarabine phosphate was shown to cause increased sister chromatid exchanges using an *in vitro* sister chromatid exchange (SCE) assay under both metabolically activated and non-activated conditions.

Fertility

Studies in mice, rats and dogs have demonstrated dose-related adverse effects on the male reproductive system. Observations consisted of a decrease in mean testicular weights in dogs and degeneration and necrosis of spermatogenic epithelium of the testes in mice, rats and dogs. These results indicate that fludarabine phosphate may adversely affect male fertility, but this has not been directly investigated in studies of reproductive function. No information is available from animal studies on potential effects on female fertility. The possible adverse effects on fertility in humans have not been adequately evaluated.

6 PHARMACEUTICAL PARTICULARS

6.1 LIST OF EXCIPIENTS

- Microcrystalline cellulose
- Lactose monohydrate
- Colloidal anhydrous silica
- Croscarmellose sodium
- Magnesium stearate
- Hypromellose
- Purified talc
- Titanium dioxide
- Iron oxide red
- Iron oxide yellow

6.2 INCOMPATIBILITIES

Incompatibilities were either not assessed or not identified as part of the registration of this medicine.

6.3 SHELF LIFE

In Australia, information on the shelf life can be found on the public summary of the Australian Register of Therapeutic Goods (ARTG). The expiry date can be found on the packaging.

6.4 SPECIAL PRECAUTIONS FOR STORAGE

Store below 25°C

6.5 NATURE AND CONTENTS OF CONTAINER

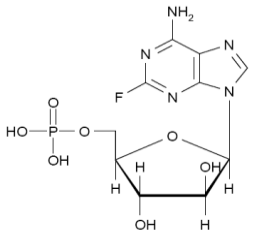
Al blister packs of 20 tablets (each blister foil contains 5 tablets).

6.6 SPECIAL PRECAUTIONS FOR DISPOSAL

In Australia, any unused medicine or waste material should be disposed of by taking to your local pharmacy.

6.7 PHYSIOCHEMICAL PROPERTIES

Chemical Structure



Molecular Formula: $C_{10}H_{13}FN_5O_7P$

Molecular Weight: 365.2

Chemical Name: 9-β-D-arabinofuranosyl-2-fluoroadenine 5'-(dihydrogen phosphate).

CAS number
21679-14-1

7 MEDICINE SCHEDULE

Prescription Only Medicine (S4)

8 SPONSOR

sanofi-aventis australia pty ltd
12-24 Talavera Road
Macquarie Park NSW 2113
Freecall: 1800 818 806
Email: medinfo.australia@sanofi.com

9 DATE OF FIRST APPROVAL

20 June 1995

10 DATE OF REVISION

14 June 2024

SUMMARY TABLE OF CHANGES

Section Changed	Summary of New Information
4.8; 4.9	Removal of NZ information and editorial update
6.5	Deletion of non-marketed pack size
8	Removal of NZ sponsor and editorial update to Australian sponsor details