

SUMMARY OF PRODUCT CHARACTERISTICS

1 NAME OF THE MEDICINAL PRODUCT

Fluorouracil 25 mg/ml Injection.

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each 1 ml contains 25mg of fluorouracil.

Presentations	250mg / 10ml	500mg / 20ml	2.5g / 100ml
Amount fluorouracil present (as sodium salt) per vial	250mg	500mg	2.5g

Excipient with known effect

Fluorouracil 250 mg/10 ml contains 40.1 mg of sodium in each vial.

Fluorouracil 500 mg/20 ml contains 80.2 mg of sodium in each vial.

Fluorouracil 2.5 g/100 ml contains 401 mg of sodium in each vial.

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Solution for injection.

Clear, colourless or slightly yellow solution.

4. CLINICAL PARTICULARS

4.1. Therapeutic indications

Fluorouracil may be used alone or in combination, for its palliative action in the management of common malignancies particularly cancer of the colon and breast.

4.2 Posology and method of administration

Adults:

Selection of an appropriate dose and treatment regime depends upon the condition of the patient, the type of carcinoma being treated and whether fluorouracil is to be administered alone or in combination with other therapy. Initial treatment should be given in hospital and the *total daily dose should not exceed 0.8 - 1 gram*. It is customary to calculate the dose in accordance with the patient's actual bodyweight unless there is obesity, oedema or some form of abnormal fluid retention such as ascites. Ideal weight is used as the basis for calculation in such cases.

Fluorouracil injection should not be mixed directly, in the same container, with other chemotherapeutic agents or intravenous additives.

Fluorouracil is often administered concomitantly with leucovorin which may potentiate the therapeutic effects of fluorouracil. Therefore, the toxicity of fluorouracil, especially GI and hematologic, may be increased. Careful monitoring should be observed and the dose of fluorouracil may be decreased based on current guidelines (see section 4.5).

The following regimens have been recommended for use as a single agent:

Initial Treatment:

This may be in the form of an infusion or an injection, the former usually being preferred because of lesser toxicity.

Intravenous infusion:

15mg/kg bodyweight, but not more than 1g per infusion, diluted in 300 - 500ml of 5% glucose or 0.9% NaCl injection and given over 4 hours. Alternatively the daily dose may be infused over 30 - 60 minutes or may be given as a continuous infusion over 24 hours. The infusion may be repeated daily until there is evidence of toxicity or a total dose of 12 - 15g has been reached.

Intravenous Injection:

12mg/kg bodyweight, but not more than the recommended 1g daily dose may be given daily for 3 days and then, if there is no evidence of toxicity, 6mg/kg on alternate days for 3 further doses.

An alternative regimen is 15mg/kg as a single intravenous injection once a week throughout the course.

Intra-arterial infusion:

5/7.5mg/kg bodyweight daily may be given by 24 hour continuous intra-arterial infusion.

Maintenance therapy:

An initial intensive course may be followed by maintenance therapy providing there are no significant toxic effects.

In all instances, toxic side effects must disappear before maintenance therapy is started. If, however, they do appear, therapy must be discontinued until the symptoms resolve.

The initial course of fluorouracil can be repeated after an interval of 4 to 6 weeks from the last dose or, alternatively, treatment can be continued with intravenous injections of 5-15mg/kg bodyweight at weekly intervals.

This sequence constitutes a course of therapy. Some patients have received up to 30g at a maximum rate of 1 g daily.

A more recent alternative method is to give 15mg/kg IV once a week throughout the course of treatment. This obviates the need for an initial period of daily administration.

In combination with irradiation

Irradiation combined with fluorouracil has been found to be useful in the treatment of certain types of metastatic lesions in the lungs and for the relief of pain caused by recurrent, inoperable growth. The standard dose of fluorouracil should be used.

Dose reduction in certain situations

The initial dose should be reduced by one-third to one half in patients with any of the following:

1. Cachexia.
2. Major surgery within preceding 30 days.
3. Reduced bone marrow function.

If the leukocyte count is $< 2.5 \times 10^9/l$ and/or the thrombocyte count is $< 75 \times 10^9/l$, the treatment should be discontinued for one week. If the blood count is normalised during this period of time, the treatment can be resumed. In other cases the dosage is as follows:

Leukocytes ($\times 10^9/l$)	Thrombocytes ($\times 10^9/l$)	Dosage
> 3.5	> 125	Recommended dose
2.5 - 3.5	75 - 125	50% of the recommended dose
< 2.5	< 75	Suspend treatment.

4. Impaired hepatic or renal function.

If plasma bilirubin concentration is >5 mg/dl, treatment with fluorouracil should be discontinued. If the patient's hepatic or renal function is impaired, the recommended dose can be reduced by 30 to 50% (see sections 4.4 and 5.2).

Children:

No recommendations are made regarding the use of fluorouracil in children.

Elderly:

Fluorouracil should be used in the elderly with similar considerations as in younger adults, notwithstanding that incidence of concomitant medical illness is higher in the former group.

Fluorouracil should be used with caution in elderly patients. The female gender and an age of 70 years or older are reported as independent risk factors for severe toxicity from fluorouracil-based chemotherapy. Close monitoring for multiple organ toxicities and vigorous supportive care of those with toxicity are necessary. Elderly patients more frequently manifest a decreased kidney function correlated to age, which makes a decrease in dosage necessary for those patients undergoing fluorouracil treatment.

4.3 Contraindications

Fluorouracil is contraindicated in patients who/ with:

- Hypersensitivity to the active substance or to any of the excipients listed in section 6.1
- Are seriously debilitated
- Are suffering from bone marrow depression after radiotherapy or treatment with other antineoplastic agents
- Are suffering from a potentially serious infection
- Have a poor nutritional state
- Are breast feeding (see section 4.6)
- Have a known complete absence of dihydropyrimidine dehydrogenase (DPD) activity (see section 4.4)
- Have been treated with brivudine, sorivudine or their chemically related analogues, which are potent inhibitors of the enzyme dihydropyrimidine dehydrogenase (DPD), which degrades fluorouracil (see section 4.5). Fluorouracil must not be taken within 4 weeks of treatment with brivudine, sorivudine or their chemically related analogues.

Fluorouracil should not be used in the management of non-malignant disease.

4.4 Special warnings and precautions for use

It is recommended that fluorouracil be given only by, or under the strict supervision of a qualified physician who is conversant with the use of potent antimetabolites.

All patients should be admitted to hospital for initial treatment.

The most pronounced and dose-limiting toxic effects of fluorouracil are on the normal, rapidly proliferating cells of the bone marrow and the lining of the gastrointestinal tract. The immunosuppressive effect of fluorouracil may cause a higher incidence of microbial infections, delayed wound healing and bleeding of the gums.

Haematological effects

Adequate treatment with fluorouracil is usually followed by leucopenia, the lowest white blood cell (W.B.C.) count commonly being observed between the 7th and 14th day of the first course, but occasionally being delayed for as long as 20 days. The count usually returns to normal by the 30th day. Daily monitoring of platelet and W.B.C. count is recommended and treatment should be stopped if platelets fall below 100,000 per mm³ or the W.B.C. count falls below 3,500 per mm³. If the total count is less than 2000 per mm³, and especially if there is granulocytopenia, it is recommended that the patient be placed in protective isolation in the hospital and treated with appropriate measures to prevent systemic infection.

Gastrointestinal effects

Treatment should be stopped at the first sign of oral ulceration or if there is evidence of gastrointestinal side effects such as stomatitis, diarrhoea or bleeding from the gastrointestinal tract or haemorrhage at any site, oesophagopharyngitis or intractable vomiting. Fluorouracil should be resumed only when the patient has recovered from the above signs. The ratio between effective and toxic dose is small and therapeutic response is unlikely without some degree of toxicity. Care must be taken therefore, in the selection of patients and adjustment of dosage.

Radiotherapy

Fluorouracil treatment may potentiate necrosis caused by radiation.

Special risk patients

Patients taking phenytoin concomitantly with fluorouracil should undergo regular testing because of the possibility of an elevated plasma level of phenytoin (see section 4.5).

Fluorouracil should be used with extreme caution in poor risk patients who have recently undergone surgery, have a history of high-dose irradiation of bone marrow-bearing areas (pelvis, spine, ribs, etc.) or prior use of another chemotherapeutic agent causing myelosuppression, have a widespread involvement of bone marrow by metastatic tumours, or those with reduced renal or liver function, jaundice or who have a poor nutritional state. Severe toxicity and fatalities are more likely in poor risk patients, but have occasionally occurred in patients who are in relatively good condition. Any form of therapy which adds to the stress of the patient, interferes with nutritional uptake or depresses the bone marrow function, will increase the toxicity of fluorouracil. If therapy is continued careful monitoring of the patient is required.

Cardiotoxicity

Cardiotoxicity has been associated with fluoropyrimidine therapy, including myocardial infarction, angina, arrhythmias, myocarditis, cardiogenic shock, sudden death, stress cardiomyopathy (takotsubo syndrome) and electrocardiographic changes (including very rare cases of QT prolongation). These adverse events are more common in patients receiving continuous infusion of 5-fluorouracil rather than bolus injection. Prior history of coronary artery disease may be a risk factor for some cardiac adverse reactions. Care should therefore be exercised in treating patients who experienced chest pain during courses of treatment, or patients with a history of heart disease. Careful consideration should be given to re-administration of Fluorouracil after a documented cardiovascular reaction (arrhythmia, angina, ST segment changes) as there is a risk of sudden death. Cardiac function should be regularly monitored during treatment with fluorouracil. In case of severe cardiotoxicity the treatment should be discontinued.

Immunosuppressant effects/Increased susceptibility to infections

Vaccination with a live vaccine should be avoided in patients receiving 5-fluorouracil due to the potential for serious or fatal infections. Killed or inactivated vaccines may be administered; however, the response to such vaccines may be diminished. Contact should be avoided with people who have recently been treated with polio virus vaccine.

Patients with leukaemia who are in remission should not receive vaccines containing weakened viruses until three months has elapsed since their last chemotherapy session. Furthermore, immunisation with orally administered vaccines containing the

poliomyelitis virus must be postponed for those persons coming into direct contact with the patient, particularly family members.

Hand-foot syndrome

The administration of fluorouracil has been associated with the occurrence of palmar-plantar erythrodysesthesia syndrome, also known as hand-foot syndrome.

Continuous-infusion fluorouracil may increase the incidence and severity of palmar-plantar erythrodysesthesia. This syndrome has been characterized as a tingling sensation of hands and feet, which may progress over the next few days to pain when holding objects or walking. The palms and soles become symmetrically swollen and erythematous with tenderness of the distal phalanges, possibly accompanied by desquamation. Interruption of therapy is followed by gradual resolution over 5 to 7 days. Supplementation of chemotherapy with oral pyridoxine has been reported to prevent or resolve such symptoms.

Encephalopathy

Cases of encephalopathies (including hyperammonaemic encephalopathy, leukoencephalopathy, posterior reversible encephalopathy syndrome [PRES], Wernicke's encephalopathy) associated with 5-fluorouracil treatment have been reported from post-marketing sources. Signs or symptoms of encephalopathy are altered mental status, confusion, disorientation, coma or ataxia. If a patient develops any of these symptoms withhold treatment and test serum ammonia and vitamin B1 levels immediately. In case of elevated serum ammonia levels or vitamin B1 deficiency initiate appropriate therapy. Hyperammonaemic encephalopathy often occurs together with lactic acidosis.

Caution is necessary when administering fluorouracil to patients with renal and/or hepatic impairment. Patients with impaired renal and/or hepatic function may have an increased risk for hyperammonaemia and hyperammonaemic encephalopathy.

Tumour Lysis Syndrome

Cases of tumour lysis syndrome associated with fluorouracil treatment have been reported from post-marketing sources. Patients at increased risk of tumour lysis syndrome (e.g. with renal impairment, hyperuricemia, high tumour burden, rapid progression) should be closely monitored. Preventive measures (e.g. hydration, correction of high uric acid levels) should be considered.

Dihydropyrimidine dehydrogenase (DPD) deficiency

DPD activity is rate limiting in the catabolism of 5-fluorouracil (see section 5.2). Patients with DPD deficiency are therefore at increased risk of fluoropyrimidines-related toxicity, including for example stomatitis, diarrhoea, mucosal inflammation, neutropenia and neurotoxicity.

DPD-deficiency related toxicity usually occurs during the first cycle of treatment or after dose increase.

Complete DPD deficiency

Complete DPD deficiency is rare (0.01-0.5% of Caucasians). Patients with complete DPD deficiency are at high risk of life-threatening or fatal toxicity and must not be treated with Fluorouracil injection (see section 4.3).

Partial DPD deficiency

Partial DPD deficiency is estimated to affect 3-9% of the Caucasian population. Patients with partial DPD deficiency are at increased risk of severe and potentially life-threatening toxicity. A reduced starting dose should be considered to limit this

toxicity. DPD deficiency should be considered as a parameter to be taken into account in conjunction with other routine measures for dose reduction. Initial dose reduction may impact the efficacy of treatment. In the absence of serious toxicity, subsequent doses may be increased with careful monitoring.

Testing for DPD deficiency

Phenotype and/or genotype testing prior to the initiation of treatment with Fluorouracil injection is recommended despite uncertainties regarding optimal pre-treatment testing methodologies. Consideration should be given to applicable clinical guidelines.

Impaired kidney function can lead to increased blood uracil levels resulting in an increased risk for misdiagnosis in patients with DPD deficiency with moderate or severe renal impairment.

Genotypic characterisation of DPD deficiency

Pre-treatment testing for rare mutations of the DPYD gene can identify patients with DPD deficiency.

The four DPYD variants c.1905+1G>A [also known as DPYD*2A], c.1679T>G [DPYD*13], c.2846A>T and c.1236G>A/HapB3 can cause complete absence or reduction of DPD enzymatic activity. Other rare variants may also be associated with an increased risk of severe or life-threatening toxicity.

Certain homozygous and compound heterozygous mutations in the DPYD gene locus (e.g. combinations of the four variants with at least one allele of c.1905+1G>A or c.1679T>G) are known to cause complete or near complete absence of DPD enzymatic activity.

Patients with certain heterozygous DPYD variants (including c.1905+1G>A, c.1679T>G, c.2846A>T and c.1236G>A/HapB3 variants) have increased risk of severe toxicity when treated with fluoropyrimidines.

The frequency of the heterozygous c.1905+1G>A genotype in the DPYD gene in Caucasian patients is around 1%, 1.1% for c.2846A>T, 2.6-6.3% for c.1236G>A/HapB3 variants and 0.07 to 0.1% for c.1679T>G.

Data on the frequency of the four DPYD variants in other populations than Caucasian is limited. At the present, the four DPYD variants (c.1905+1G>A, c.1679T>G, c.2846A>T and c.1236G>A/HapB3) are considered virtually absent in populations of African (-American) or Asian origin.

Phenotypic characterisation of DPD deficiency

For phenotypic characterisation of DPD deficiency, the measurement of pre-therapeutic blood levels of the endogenous DPD substrate uracil (U) in plasma is recommended.

Elevated pre-treatment uracil concentrations are associated with an increased risk of toxicity. Despite uncertainties on uracil thresholds defining complete and partial DPD deficiency, a blood uracil level ≥ 16 ng/ml and < 150 ng/ml should be considered indicative of partial DPD deficiency and associated with an increased risk for fluoropyrimidine toxicity. A blood uracil level ≥ 150 ng/ml should be considered indicative of complete DPD deficiency and associated with a risk for life-threatening or fatal fluoropyrimidine toxicity. Blood uracil levels should be interpreted with

caution in patients with impaired kidney function (see ‘Testing for DPD deficiency’ above).

5-Fluorouracil Therapeutic drug monitoring (TDM)

TDM of 5-fluorouracil may improve clinical outcomes in patients receiving continuous 5-fluorouracil infusions by reducing toxicities and improving efficacy. AUC is supposed to be between 20 and 30mg x h/L.

Nucleoside analogues, e.g. Brivudine and sorivudine, which affect DPD activity may cause increased plasma concentrations and increased toxicity of fluoropyrimidines (see section 4.5). Therefore, an interval of at least 4 weeks between administration of fluorouracil and Brivudine, sorivudine or analogues should be kept. In the case of accidental administration of nucleoside analogues to patients treated with fluorouracil, effective measures should be taken to reduce fluorouracil toxicity. Immediate hospitalisation is recommended. Any measure to prevent systemic infections and dehydration should be commenced.

Photosensitivity reactions:

Some patients may experience photosensitivity reactions following administration of fluorouracil, it is recommended that patients are warned to avoid prolonged exposure to sunlight (see section 4.8).

Embryo-foetal toxicity

Fluorouracil showed evidence of genotoxicity. An highly effective method of contraception is required for both male and female patients during and for a period after treatment with fluorouracil. Patients desiring to have children after completion of therapy should be advised to obtain genetic counselling before therapy if appropriate and available (see sections 4.6 and 5.3).

Sodium content

Fluorouracil 250 mg/10 ml contains 40.1 mg of sodium in each vial, equivalent to 2% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

Fluorouracil 500 mg/20 ml contains 80.2 mg of sodium in each vial, equivalent to 4% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

Fluorouracil 2.5 g/100 ml contains 401 mg of sodium in each vial, equivalent to 20% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

This medicinal product may be further prepared for administration with sodium-containing solutions (see section 6.6) and this should be considered in relation to the total sodium from all sources that will be administered to the patient.

4.5 Interaction with other medicinal products and other forms of interaction

Various purines, pyrimidines, and antimetabolites have shown biochemical modulation of fluorouracil in *in vitro* test systems. Purines include inosine, guanosine, guanosine-5'-phosphate and deoxyinosine. Pyrimidines include thymidine, uridine and cytidine. Antimetabolites include methotrexate, tamoxifen, interferon, phosphonoacteyl-L-aspartate (PALA), allopurinol, hydroxyurea, dipyridamol and leucovorin (folinic acid). Synergistic cytotoxic interactions, such as those involving fluorouracil with leucovorin, have shown beneficial therapeutic effects, particularly in colon cancer. However, the drug combination may result in increased clinical toxicity (gastrointestinal side effects) of the fluorouracil component. Other drugs include metronidazole and cimetidine. Pretreatment with cimetidine prior to intravenous

fluorouracil increased the fluorouracil area under the concentration versus time curve (AUC) by 27%. The total body clearance was reduced by 28%. This may lead to increased plasma concentrations of fluorouracil.

Calcium folinate (leucovorin)

Leucovorin calcium enhances the binding of fluorouracil to thymidylate synthase, which may lead to increased antitumour efficacy and toxicity of fluorouracil (see section 4.2).

Warfarin

Marked elevations of prothrombin time and INR have been reported in a few patients stabilised on warfarin therapy following initiation of fluorouracil regimes.

Brivudine and sorivudine

Brivudine, sorivudine or their chemically related analogues irreversibly inhibit DPD, resulting in a significant increase in fluorouracil exposure. This may lead to increased fluoropyrimidine-related toxicities with potentially fatal outcome. Therefore, either a different antiviral therapy may be used or there should be an interval of at least 4 weeks between the administration of brivudine, sorivudine, or the analogues and the start of fluorouracil treatment (see section 4.3). In the case of accidental administration of nucleoside analogues that inhibit DPD activity to patients treated with fluorouracil, effective measures should be taken to reduce fluorouracil toxicity. Immediate hospitalisation is recommended.

Levamisole

Combination therapy with fluorouracil and levamisole has been associated with multifocal inflammatory leukoencephalopathy (MILE). Symptoms may include memory loss, confusion, paraesthesia, lethargy, muscle weakness, speech disturbances, coma and seizures. The cerebrospinal fluid may show mild pleiocytosis, and computed tomography and magnetic resonance scans may show lesions in the white matter suggestive of demyelination. If this syndrome occurs, treatment should be discontinued immediately. The condition is at least partially reversible if fluorouracil and levamisole are discontinued, and corticosteroids given. The use of levamisole and fluorouracil is no longer recommended by NH&MRC 'Clinical Practice guidelines: The prevention, early detection and management of colorectal cancer'. This combination regimen has been superseded by fluorouracil and leucovorin.

Phenytoin

Increased phenytoin plasma concentrations have been reported during concomitant use of phenytoin with capecitabine or its metabolite fluorouracil. Formal interaction studies between phenytoin and capecitabine have not been conducted, but the mechanism of interaction is presumed to be inhibition of CYP2C9 isoenzyme system by capecitabine. Serum levels of phenytoin sustained above the optimal range may produce encephalopathy, or confusional states (delirium psychosis), or rarely irreversible cerebellar dysfunction. Therefore, patients taking phenytoin concomitantly with capecitabine or fluorouracil should be regularly monitored for increased phenytoin plasma levels (see section 4.4).

Laboratory values

Fluorouracil treatment may interfere with some laboratory tests. Increases in total serum thyroxine concentration (due to increased binding to globulin) have been reported.

4.6 Fertility, pregnancy and lactation

Pregnancy

There are no adequate and well-controlled studies in pregnant women, however, foetal defects and miscarriages have been reported.

If the drug is used during pregnancy, or if the patient becomes pregnant while taking the drug, or plans to become pregnant prior to beginning of therapy, the patient should be fully informed of the potential hazard to the foetus and genetic counselling is recommended if appropriate and available. Fluorouracil should be used during pregnancy only if the potential benefit justifies the potential risk to the foetus.

Fluorouracil may cause fetal harm when administered to pregnant women. There is only limited data available on the teratogenic effects of fluorouracil in humans. Fluorouracil was foetotoxic and teratogenic in mice, rats, and hamsters (see Section 5.3). Therefore, fluorouracil can be considered an agent that can cause fetal malformations.

Fluorouracil should not be used during pregnancy unless the clinical condition of the patient requires treatment with fluorouracil.

Women of childbearing potential

Women of childbearing potential should be advised to avoid becoming pregnant and use a highly effective method of contraception during treatment with Fluorouracil and at least 6 months afterwards.

Fertility

Men treated with Fluorouracil are advised not to father a child during and for up to 3 months following cessation of treatment. Advice on fertility preservation should be sought prior to treatment by both male and female patients because of the possibility of irreversible infertility due to therapy with Fluorouracil.

Effects of fluorouracil on the gonads and reproduction capacity of humans are not fully known. However, studies in animals indicate impaired male and female fertility (see section 5.3). Also, drugs which inhibit DNA, RNA, and protein synthesis (such as fluorouracil), presumably interfere with gametogenesis.

Breast-feeding

Since it is not known whether Fluorouracil passes into breast milk, breast-feeding must be discontinued if the mother is treated with Fluorouracil (see section 4.3).

4.7 Effects on ability to drive and use machines

No studies on the effects on the ability to drive and use machinery have been performed.

Fluorouracil may induce side effects such as nausea and vomiting. It can also produce adverse events of the nervous system and visual changes which could interfere with driving or the usage of heavy machinery.

4.8 Undesirable effects

The following undesirable effects have been observed and reported during treatment with Fluorouracil Injection with the following frequencies:

Very common ($\geq 1/10$),

Common ($\geq 1/100$ to $< 1/10$),

Uncommon ($\geq 1/1,000$ to $< 1/100$),

Rare ($\geq 1/10,000$ to $< 1/1,000$),

Very rare ($< 1/10,000$),

Frequency not known (cannot be estimated from the available data).

Infections and infestations:	
Very common	Infections
Blood and lymphatic system disorders:	
Very common	Myelosuppression (leucopenia, pancytopenia and thrombocytopenia); agranulocytosis, anaemia
Common	Febrile neutropenia
Immune system disorders:	
Very common	Bronchospasm, Immunosuppression with an increased risk of infection.
Rare	Hypersensitivity reactions, generalised anaphylactic and allergic reactions.
Metabolism and nutrition disorders:	
Frequency not known	Lactic acidosis, tumour lysis syndrome, hypertriglyceridaemia, vitamin B1 deficiency
Psychiatric disorders:	
Uncommon	Euphoria
Rare	a reversible confusional state may occur
Very rare	Disorientation
Nervous system disorders	
Uncommon	Nystagmus, headache, dizziness, symptoms of Parkinson's disease, pyramidal signs, and somnolence
Very rare	Cases of leukoencephalopathy have also been reported. With symptoms including ataxia, acute cerebellar syndrome, dysarthria, myasthenia, aphasia, convulsion or coma in patients receiving high doses of 5-fluorouracil and in patients with dihydropyrimidine dehydrogenase deficiency, kidney failure
Frequency not known	Peripheral neuropathy may occur, Hyperammonaemic encephalopathy, Posterior reversible encephalopathy syndrome (PRES), Wernicke's encephalopathy
Eye disorders:	
Uncommon	Incidences of excessive lacrimation, dacryostenosis, visual changes and photophobia.
Cardiac disorders	

Very common	ECG changes
Common	Angina pectoris-like chest pain
Uncommon	Arrhythmia, myocardial infarction, myocardial ischaemia, dilative cardiomyopathy
Very rare	Cardiac arrest and sudden cardiac death
Frequency not known	Stress cardiomyopathy (takotsubo syndrome), pericarditis, tachycardia, breathlessness, cardiac shock, cardiac failure, myocarditis
Special attention is therefore advisable in treating patients with a history of heart disease or those who develop chest pain during treatment.	
Vascular disorders:	
Rare	Cerebral, intestinal and peripheral ischemia, Reynaud's syndrome, thromboembolism, thrombophlebitis
Uncommon	Hypotension
Gastrointestinal disorders:	
Very common	Diarrhoea, nausea and vomiting are observed quite commonly during therapy and may be treated symptomatically. An anti-emetic may be given for nausea and vomiting. Additionally, events of anorexia, stomatitis (symptoms include soreness, erythema or ulceration of the oral cavity or dysphagia); proctitis, oesophagitis
Uncommon	Gastrointestinal ulcerations and bleeding (may result in therapy being discontinued)
Frequency not known	Pneumatosis intestinalis, enterocolitis, colitis (including necrotising colitis)
Hepatobiliary disorders:	
Very common	Hepatocellular injury
Skin and subcutaneous tissue disorders:	
Very common	Alopecia may be seen in a substantial number of cases particularly in females but is reversible. Palmar-plantar erythrodysesthesia syndrome has been reported as an unusual complication of high dose bolus or protracted continuous therapy for 5-fluorouracil. The syndrome begins with dysaesthesia of the palms and soles that progress to pain and tenderness. There is associated symmetrical swelling and erythema of the hand and foot.
Uncommon	Other side effects include dermatitis, pigmentation, changes in the nails (e.g. diffuse superficial blue pigmentation, hyperpigmentation, nail dystrophy, pain and thickening of the nail bed, paronychia), dry skin, fissure erosion, erythema, pruritic maculopapular rash, exanthema, photosensitivity, hyperpigmentation of the skin, streaky hyperpigmentation or depigmentation near the veins.
Frequency not known	Cutaneous lupus erythematosus
General disorders and administration site conditions	
Very Common	Malaise, weakness
Frequency not known	Fever, vein discolouration proximal to injection sites, local reaction caused by extravasation (pain, swelling, erythema)

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation 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 via the Yellow Card Scheme at: www.mhra.gov.uk/yellowcard or search for MHRA Yellow Card in the Google Play or Apple App Store.

4.9 Overdose

The possibility of overdosage with fluorouracil is unlikely in view of the mode of administration. High dosages or prolonged treatment with fluorouracil can result in life-threatening intoxication symptoms such as; nausea, vomiting, diarrhoea, gastrointestinal ulceration and bleeding, bone marrow depression (including thrombocytopenia, leukopenia, agranulocytosis).

Uridine triacetate is a specific antidote for the treatment of 5-fluorouracil overdose or the treatment of severe early-onset toxicities. It should be administered within 96 hours after end of 5-fluorouracil infusion. In the event uridine triacetate is not available, treatment is symptomatic and supportive.

Patients in which an overdose of fluorouracil is detected should be closely monitored haematologically for at least 4 weeks.

5 PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Antineoplastic agents; Antimetabolites; Pyrimidine analogues
ATC code: L01BC02

Fluorouracil is an analogue of uracil, a component of ribonucleic acid. The drug is believed to function as an antimetabolite. After intracellular conversion to the active deoxynucleotide, it interferes with the synthesis of DNA by blocking the conversion of deoxyuridylic acid to thymidylic acid by the cellular enzyme thymidylate synthetase. Fluorouracil can also be incorporated into RNA, resulting in formation of defective RNA.

5.2 Pharmacokinetic properties

Absorption and Distribution

After intravenous administration, fluorouracil is distributed through the body water and disappears from the blood within 3 hours. It is preferentially taken up by actively dividing tissues and tumours after conversion to its nucleotide. Fluorouracil readily enters the C.S.F. and brain tissue.

Biotransformation

5-fluorouracil is catabolised by the enzyme dihydropyrimidine dehydrogenase (DPD) to the much less toxic dihydro-5-fluorouracil (FUH₂). Dihydropyrimidinase cleaves the pyrimidine ring to yield 5-fluoro-ureidopropionic acid (FUPA). Finally, β -ureido-propionase cleaves FUPA to α -fluoro- β -alanine (FBAL) which is cleared in the urine.

Dihydropyrimidine dehydrogenase (DPD) activity is the rate limiting step. Deficiency of DPD may lead to increased toxicity of 5-fluorouracil (see section 4.3 and 4.4).

Elimination

Following I.V. administration, the plasma elimination half-life averages about 16 minutes and is dose dependent. Following a single I.V. dose of Fluorouracil approximately 15% of the dose is excreted unchanged in the urine within 6 hours; over 90% of this is excreted in the first hour. The remainder is mostly metabolised in the liver by the usual body mechanisms for uracil.

Special populations

In patients with hepatic or renal failure, biotransformation and/or elimination of fluorouracil is reduced, requiring a reduction in dose rate (see sections 4.2 and 4.4).

5.3 Preclinical safety data

Adverse effects of fluorouracil have been reported in repeat-dose studies in rats, cats, and dogs. The main organs of toxicity in rats were the gastrointestinal tract, haemolymphopoietic system, liver, kidneys, and testes. Cardiotoxicity was observed in rats and neurotoxicity in cats and dogs.

Fluorouracil was genotoxic in the majority of the in vitro or in vivo studies performed.

Nonclinical data are inconclusive with respect to carcinogenicity. Nevertheless, the risk of carcinogenicity cannot be totally excluded.

Findings in repeat-dose toxicity studies indicate that fluorouracil has the potential to impact reproductive function and fertility in male rats. Fluorouracil was toxic to male reproductive organs, causing changes in spermatogonia chromosomal organisation, inhibition of spermatogonial differentiation and transient infertility in male rats. Administration of ≥ 25 mg/kg (0.33x a human dose of 12 mg/kg, based on body surface area) weekly for 3 weeks to female rats resulted in reduced female fertility, preimplantation loss, and increased chromosomal anomalies in embryos.

Fluorouracil was foetotoxic and teratogenic in mice, rats, and hamsters. Based on the teratogenic effects detected in animal studies (in which the doses used were 1 to 3 times higher than the maximum recommended dose for humans), fluorouracil can be considered an agent that can cause foetal malformations. Foetal malformations included cleft palate, skeletal defects, and deformed appendages and tails. Potential effects of fluorouracil on peri and postnatal development have not been studied in animals. However, in rats fluorouracil has been found to cross the placental barrier and to cause foetal mortality.

6. PHARMACEUTICAL PARTICULARS

6.1. List of excipients

Sodium hydroxide
Water for Injections.

6.2 Incompatibilities

Admixtures with acidic drugs or drugs that are unstable in the presence of alkali should be avoided. Fluorouracil is reported to be incompatible with cytarabine, diazepam, methotrexate, platinum compounds, doxorubicin (and presumably other anthracyclines that are unstable at alkaline pH), and calcium folinate (leucovorin).

6.3. Shelf life

Before use: 24 months

In use: Chemical and physical in-use stability has been demonstrated for 5 days at 20-21°C.

From a microbiological point of view, the product should be used immediately. If not used immediately, in-use storage times and conditions prior to use are the responsibility of the user and would not normally be longer than 24 hours at 2-8 °C, unless dilution has taken place in controlled and validated aseptic conditions.

6.4. Special precautions for storage

Do not store above 25°C. Do not refrigerate or freeze. Keep container in the outer carton.

The pH of fluorouracil injection is 8.9 and the drug has maximal stability over the pH range 8.6 to 9.0.

If a precipitate has formed as a result of exposure to low temperatures, redissolve by heating to 60°C accompanied by vigorous shaking. Allow to cool to body temperature prior to use.

The product should be discarded if it appears brown or dark yellow in solution.

6.5 Nature and contents of container

Type I Conventional Clear Glass Vials with rubber closures.
Type I Clear Onco-Tain[®] Vials with rubber closures.

250 mg/10ml: Pack Size 5.

500 mg/20ml: Pack Size 10.

2.5 g/100 ml: Pack Size Singles and 10's.

Not all presentations or pack sizes may be marketed.

6.6 Special precautions for disposal

Cytotoxic Handling Guidelines

Should be administered only by or under the direct supervision of a qualified physician who is experienced in the use of cancer chemotherapeutic agents.

Fluorouracil Injection should only be prepared for administration by professionals who have been trained in the safe use of the preparation. Preparation should only be carried out in an aseptic cabinet or suite dedicated for the assembly of cytotoxics.

In the event of spillage, operators should put on gloves, face mask, eye protection and disposable apron and mop up the spilled material with an absorbent material kept in the area for that purpose. The area should then be cleaned and all contaminated material transferred to a cytotoxic spillage bag or bin and sealed for incineration.

Contamination

Fluorouracil is an irritant, contact with skin and mucous membranes should be avoided.

In the event of contact with the skin or eyes, the affected area should be washed with copious amounts of water or normal saline. A bland cream may be used to treat the transient stinging of the skin. Medical advice should be sought if the eyes are affected or if the preparation is inhaled or ingested.

Please refer to company for COSHH hazard datasheets.

Preparation Guidelines

- a) Chemotherapeutic agents should be prepared for administration only by professionals who have been trained in the safe use of the preparation.
- b) Operations such as reconstitution of powder and transfer to syringes should be carried out only under aseptic conditions in a suite or cabinet dedicated for the assembly of cytotoxics.
- c) The personnel carrying out these procedures should be adequately protected with clothing, gloves and eye shield.
- d) Pregnant personnel are advised not to handle chemotherapeutic agents.

Disposal

Syringes, Onco•Vials[®] and adaptors containing remaining solution, absorbent materials, and any other contaminated material should be placed in a thick plastic bag or other impervious container and incinerated at 700°C.

Diluents

Fluorouracil Injection may be diluted with Glucose 5% Injection or Sodium Chloride 0.9% Injection or Water for Injections immediately before parenteral use.

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Date of latest renewal: 19 July 2004

10 DATE OF REVISION OF THE TEXT

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