

## **PRODUCT MONOGRAPH**

### **PrDaunorubicin Injectable Solution (Daunorubicin Hydrochloride)**

**20 mg/4 mL and 50 mg/10 mL  
Solution for Injection**

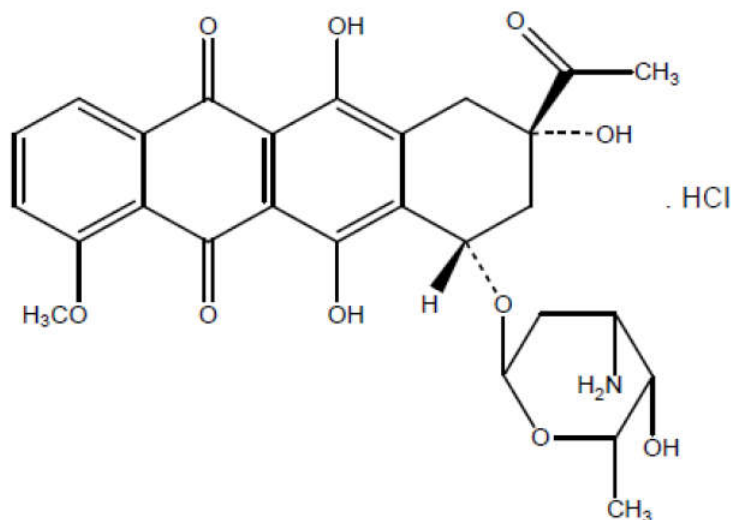
**Antimitotic—Antibiotic**

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Date of Preparation: July 2, 2020  
Control #: 230856

## **PHYSICAL AND CHEMICAL DESCRIPTION**

Daunorubicin (R.P. 13 057) is an antibiotic produced by *Streptomyces coeruleorubidus*. It is the hydrochloride of 4-methoxy 6, 9, 11-trihydroxy 7, 8, 9, 10-tetrahydro (2, 3, 6-trideoxy 3-amino L-lyxo-1-hexopyranosyl) 7-oxy-9-acetyl 5, 12-naphthacenequinone. Its structural formula is as follows:



Molecular weight: 563.98 g/mol

The hydrochloride is an orange-red crystalline powder. It is freely soluble in water and in methanol. It is slightly soluble in alcohol and chloroform. It is practically insoluble in acetone.

## **PROPERTIES**

Daunorubicin inhibits the synthesis of nucleic acids, both by binding desoxyribonucleic acid and by inhibiting the reproduction of desoxyribonucleic acid and the synthesis of ribonucleic acid in the cell nucleus. As a result there is an interruption of cell division.

## **INDICATIONS**

Daunorubicin Injectable Solution is indicated in the initial treatment of myeloblastic and acute lymphoblastic leukemias. It can also induce a remission in patients suffering from chronic myeloid leukemia, reticulosarcoma, Ewing or Wilms' tumors and lymphosarcoma. CONTRAINDICATIONS

## **CONTRAINDICATIONS**

Daunorubicin Injectable Solution must not be administered to patients who exhibit myocardial lesions or to those above 75 years of age (See WARNINGS and PRECAUTIONS).

## **WARNINGS & PRECAUTIONS**

Infections should be treated before the start of Daunorubicin Injectable Solution therapy. If during Daunorubicin Injectable Solution treatment a patient becomes febrile (regardless of the neutrophil

count), treatment with broad spectrum antibiotics should be initiated.

Daunorubicin Injectable Solution induces medullary aplasia and leukopenia. It is therefore imperative that patients be protected against infection during the period of aplasia.

Daunorubicin Injectable Solution treatment may lead to hyperuricaemia as a consequence of tumour lysis syndrome at the start of therapy. The increase in uric acid in the blood due to leukocyte degradation can be controlled by administering allopurinol and liquids to stimulate urine excretion. Caution must be exercised in patients with renal insufficiency.

Cases of colitis, enterocolitis and neutropenic enterocolitis (typhlitis) have been observed in patients treated with daunorubicin. Treatment discontinuation and prompt appropriate medical management are recommended.

Daunorubicin Injectable Solution can cause tissue necrosis, thus great care must be taken to inject the product directly into the vein.

When Daunorubicin Injectable Solution is employed in association with other anticancer agents, the dosage of each should be reduced so as to minimize the total toxic effect.

Some instances of cardiotoxicity leading to congestive heart failure may be observed when a cumulative dose of 25 mg/kg has been reached; in general, this dose must not be exceeded except in certain desperate cases where 30 mg/kg can be administered. Likewise, because of possible cardiotoxicity, the drug must not be administered to patients who exhibit myocardial lesions or to those above 75 years of age.

Before initiating treatment with Daunorubicin Injectable Solution, physical examination, appropriate x-rays and ECG should be performed and repeated at regular intervals thereafter, particularly when the cumulative dose has reached 15 mg/kg.

It is also recommended that Daunorubicin Injectable Solution be employed only as a treatment to induce a remission, and not as maintenance therapy.

### **ADVERSE REACTIONS**

At the start of treatment, the patient may experience anorexia, nausea and vomiting. These are transient effects and generally do not require an interruption of treatment. Antiemetics may help relieve vomiting.

Abdominal pain, constipation or diarrhea, alopecia, rash, petechiae or purpura may be observed during therapy.

Some cases of thrombocytopenia and anemia have been reported during the first or second week of treatment. These phenomena are transient and corrective measures such as blood or platelet transfusions are rarely required.

During the aplastic phase, cases of localized infection have occurred, particularly in the buccal cavity and pharynx. Septicemia not responsive to antibiotics has also been reported.

Some cases of cardiopathy attended by congestive heart failure, rhythm abnormalities, electrical modifications and indications of cardiac insufficiency have been observed in patients receiving a cumulative dose exceeding 30 mg/kg.

In young patients, the urine occasionally acquires a red tint. This coloration is due to the presence

of Daunorubicin Injectable Solution and its metabolites and has no clinical significance.

During treatment with combinations of daunorubicin with other antileukemic agents, there have been occurrences of myalgia and neuropathy. These symptoms, already associated with the use of other agents, have not been directly attributed to daunorubicin.

Secondary leukaemias have been reported in patients treated with daunorubicin combination with other antineoplastics.

In every patient bone marrow function will be depressed by treatment with daunorubicin and in a variable proportion of cases, severe aplasia will develop. The consequence may include severe infection and opportunistic infection.

Serious infection is a very common risk (including sepsis, septic shock and pneumonia), which sometimes can be fatal.

Tumour lysis syndrome has been observed during daunorubicin treatment.

Cases of colitis, neutropenic enterocolitis (typhlitis), enterocolitis have been reported.

## **PHARMACOLOGY**

Daunorubicin inhibits the synthesis of nucleic acids; its effect on desoxyribonucleic acid is particularly rapid and marked. Ribonucleic acid is more gradually affected.

It appears that the action of the drug is the result of the formation of a complex with desoxyribonucleic acid in the cell nucleus; this blocks the site of action of the polymerases and gives daunorubicin a cytostatic activity. Daunorubicin displays an immunosuppressive action as demonstrated by the inhibition of the production of heterohemagglutinins, by the prolongation of tolerance of skin grafts in mice and by the marked reduction of systemic lesions and arthritis provoked by Freund's complete adjuvant in the rat. Nevertheless, at non-toxic doses (1.25 mg/kg I.P.) daunorubicin does not decrease the number of immunologically active splenic cells in the mouse.

Daunorubicin has no effect on respiration or cellular glycolysis up to elevated concentrations which would inhibit cell growth.

*In vitro*, up to a concentration of 2.3 mcg/mL, daunorubicin partially inhibits KB cells cultivated in stationary tubes and exerts a total inhibition at a concentration of 4.6 mcg/mL.

It exerts an antiviral effect on the herpes and on the vaccine viruses of the desoxyribonucleic acid group, but not on the polio or influenza virus of the ribonucleic acid group.

*In vivo*, in the mouse, chicken and rabbit, daunorubicin provides a variable anti-tumor activity on grafted tumors and on tumors which appear either spontaneously or as a result of a virus.

In the mouse, it exerts a potent effect (I.V., I.P.) on grafted mammary adenomas, a moderate effect on pulmonary papillary adenomas, but only a slight effect on solid Ehrlich adenocarcinoma at a dose of 3mg/kg S.C. for 6 days. By the I.P. route, daunorubicin is effective against tumors and by the S.C. route, against solid sarcomas when treatment is instituted immediately after the graft.

The drug possesses a significant inhibitory action on the Shope fibroma when administered by the S.C. route in the rabbit.

In the reticulosarcoma of mice, daunorubicin, administered by the I.P. route, reduces the weight of the spleen by 55% and prolongs the life of the animal by 25%. Administered I.P., daunorubicin is also extremely effective in lymphoblastic leukemia and demonstrates a good effect on C 1498 myeloid leukemia. It is also very active by the I.P. route in L 1210 leukemia and Rauscher leukemia.

In the anesthetized dog, a dose of 5 mg/kg I.V. of daunorubicin does not produce any significant changes in arterial pressure and no effects were observed on the ECG or pulse. However, the same dose in the dog under pentobarbital anesthesia with atropine, produces an immediate and sustained (4 to 20 hours) reduction (10%) of cardiac rhythm, but without appreciably affecting the contracting force of the right ventricle, the blood pressure, or respiratory rate and amplitude. The drug exerts no clear effect on the sympathetic and parasympathetic systems.

Daunorubicin is inactive when administered orally.

## **TERATOGENICITY STUDIES**

No teratological effects have been observed in the chicken embryo, even at embryotoxic doses. In the mouse, prolonged treatment at a dose of 1.15 mg/kg S.C. daily did not interfere with gestation or produce any teratogenic effects.

In rabbits, doses of 0.09 mg/kg and 0.25 mg/kg I.V. induced 66% and 100% abortions respectively; in some fetuses, abnormalities which could not be attributed to drug, were observed.

Acute toxicity – The acute toxicity of daunorubicin is approximately 20 mg/kg in the mouse, 6mg/kg in the guinea pig, 4 mg/kg in the dog and between 12.5 and 25 mg/kg in the rat. The animals usually died from the third post-drug day. No particular toxic symptoms were observed, except that the animals languished in a state of profound torpor.

Chronic toxicity – Daily injections of 0.25, 0.50 and 1 mg/kg I.V. for 3 months in the rabbit did not produce mortality. The appearance and behavior of the animals remained normal. At the 1mg/kg dose, anemia, benign leukopenia and a slight slowing in weight gain were observed, but these effects disappeared spontaneously by the sixth week. At higher doses (2 mg/kg), the animals dies between the 4<sup>th</sup> and the 10<sup>th</sup> day.

In the dog, a daily dose of 0.25 mg/kg for 3 months was well tolerated. No abnormalities were observed in the hemogram or bone marrow but there were testicular alterations with apparently irreversible total aspermatogenesis. At more elevated dosages (0.5 and 1 mg/kg), tolerance is rather poor with marked harmful effects on the blood.

## **DOSAGE AND ADMINISTRATION**

Daunorubicin Injectable Solution is reserved mainly for the initial therapy of acute leukemia and other forms of malignant tumors which are sensitive to the drug.

It is administered by the I.V. route only. Daunorubicin Injectable Solution is injected into the tubing of a running infusion of 100 or 250 mL isotonic solution. The infusion is performed rapidly to avoid local stasis.

### Initial treatment

#### A) Daunorubicin Injectable Solution alone

Acute lymphoblastic leukemia - Daunorubicin Injectable Solution is instituted at a daily dose of 1 mg/kg (30 mg/m<sup>2</sup>) over a period of 3 to 6 days. If, after this first administration, the number of white cells is less than 1 500, maintenance therapy is begun. However, if a partial remission is obtained, but the number of leukocytes is greater than 1 500, treatment should be repeated 1 or more times, as necessary, based on the hematological response. As soon as the remission is obtained, maintenance treatment can be started. The total dose during the initial treatment should not, as a rule, exceed 20 mg/kg.

Acute myeloblastic, granulocytic and promyelocytic leukemias - A daily dose of 2 mg/kg (60 mg/m<sup>2</sup>) is administered for a period of 3 to 6 days, plus 1 or 2 supplementary injections which are given a few days after a remission is obtained if the blasts have not completely disappeared from the peripheral blood or marrow. The total dose varies from 3 to 22.5 mg/kg (90 to 600 mg/m<sup>2</sup>). During the initial therapy, blood should be examined every day and marrow 2 or 3 times a week.

B) Combination therapy

When Daunorubicin Injectable Solution is given in association with other antileukemic medication, it must be given every 2 or 3 days to avoid complete marrow aplasia; the treatment extends for a period of 2 to 4 weeks. It is recommended that hemograms be conducted before each injection and if they manifest a severe perturbation of the blood count, the medication should be stopped.

The dosage is from 1 mg/kg per injection every 2 or 3 days up to a total of 12 mg/kg. If only an incomplete remission is obtained after this treatment, Daunorubicin Injectable Solution can be continued up to the maximum dose of 20 mg/kg which must not be exceeded during any one treatment period. As soon as a complete remission is obtained the drug is withdrawn and maintenance treatment instituted.

Maintenance therapy

Any standard chemotherapeutic agent may be employed during maintenance therapy. If the marrow is not completely ablastic in the course of 4 weeks, a weekly injection of 1 mg/kg Daunorubicin Injectable Solution may be given.

Cumulative Doses

As a rule the total cumulative dose should not exceed 25 mg/kg, e.g., approximately 500 mg/m<sup>2</sup> for a child of 10 kg; 600 mg/m<sup>2</sup> for a child of 20 kg; 750 mg/m<sup>2</sup> for a child of 30 kg and 900 mg/m<sup>2</sup> for an adult of 60 kg. In patients who have become resistant to all therapy and for whom a final effort is required to induce a remission, the total cumulative dose can be extended to 30 mg/kg.

Chronic Myeloid Leukemia

Injections of 1 to 2 mg/kg may be administered every day or every other day up to a total dose of 6 to 12 mg/kg.

### **VIAL COMPOSITION**

Each 20 mg/4 mL vial contains daunorubicin (as hydrochloride) 20 mg and non-medical ingredients sodium chloride, hydrochloric acid, sodium hydroxide, water for injection and nitrogen. Each 50 mg/10 mL vial contains daunorubicin (as hydrochloride) 50 mg and non-medical ingredients sodium chloride, hydrochloric acid, sodium hydroxide, water for injection and nitrogen. Each mL of solution contains 5 mg of daunorubicin base.

### **AVAILABILITY OF DOSAGE FORM**

**Daunorubicin Injectable Solution** 20 mg/4 mL and 50 mg/10 mL are supplied in cartons of 1 vial.

### **STABILITY AND STORAGE RECOMMENDATIONS**

Store unopened vials of **Daunorubicin Injectable Solution** in refrigerator between 2°C and 8°C. Store prepared solution for infusion at room temperature 15°C and 30°C. Solution should be used within 24 hours if stored between 15°C and 30°C. Protect from light.



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