SUMMARY OF PRODUCT CHARACTERISTICS

1 NAME OF THE MEDICINAL PRODUCT

CARMUSTINE RAZ 100MG

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each vial of powder contains 100 mg carmustine.

Each vial of solvent contains 3 ml dehydrated alcohol (that is equivalent to 2.37 g).

For excipients, see 6.1

3 PHARMACEUTICAL FORM

Powder and solvent for concentrate for solution for infusion.

Appearance of powder for reconstitution: Yellowish.

Appearance of solvent: Clear, colorless, mobile liquid.

Appearance of reconstituted solution: clear colorless to yellowish solution, essentially free from visible contamination.

pH: 4.0 to 6.8.

The osmolarity of the solution for infusion that is reconstituted with dehydrated ethanol and sterilized water is 15.6 mOsmol/l. The solution for infusion that is diluted with physiological saline or with 5% glucose solution is isotonic with the plasma.

4 CLINICAL PARTICULARS

4.1 Therapeutic indications

Carmustine Raz 100mg is indicated as palliative therapy as a single agent or in established combination therapy with other approved agents in the following:

- Brain tumors - glioblastoma, medulloblastoma, astrocytoma and metastatic brain tumors.
- Multiple myeloma - in combination with glucocorticoid such as prednisone.

- Hodgkin's disease - as secondary therapy in combination with other approved drugs in patients who relapse while being treated with primary therapy, or who fail to respond to primary therapy.
- Non-Hodgkin's lymphomas - as secondary therapy in combination with other approved drugs in patients who relapse while being treated with primary therapy, or who fail to respond to primary therapy.

4.2 Posology and method of administration

Adults:

Posology of intravenous administration:
The recommended dose of Carmustine Raz 100mg as a single agent in previously untreated patients is 150 to 200 mg/m^2 intravenously every 6 weeks. This may be given as a single dose or divided into two daily injections such as 75 to 100 mg/m^2 on two successive days.

When Carmustine Raz 100mg is used in combination with other myelosuppressive medicinal products or in patients in whom bone marrow reserve is depleted, the doses should be adjusted accordingly.

A repeat course of Carmustine Raz 100mg should not be given until circulating blood elements have returned to acceptable levels (platelets above 100,000/ mm^3, leukocytes above 4,000/ mm^3), and this is usually in six weeks. Blood counts should be monitored frequently and repeat courses should not be given before six weeks because of delayed hematologic toxicity.

Doses subsequent to the initial dose should be adjusted according to the hematologic response of the patient to the preceding dose in both monotherapy as well as in combination therapy with other myelosuppressive medicinal products. The following schedule is suggested as a guide to dosage adjustment:

Nadir after Prior Dose		*Percentage of prior dose to be given*
Leucocytes/ mm^3	*Platelets/* mm^3	
>4000	>100,000	100
3000 - 3999	75,000 - 99,999	100
2000 - 2999	25,000 - 74,999	70
<2000	<25,000	50

Children:
Carmustine should be used with extreme caution in children due to the high risk of pulmonary toxicity (see Warnings).

Elderly:
In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dose range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.
Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and renal function should be monitored.

Method of administration:
Following reconstitution (please, see Section 6.6) with sterile diluent (3 ml vial provided) and dilution with water for injection, Carmustine Raz 100mg should be administered by intravenous drip over one to two hour period. The time of infusion should not be less than one hour otherwise it leads to burning and pain at the injected area. The injected area should be monitored during the administration.
There are no limits for the period of application of carmustine therapy. In case the tumor remains uncurable or some serious or untolerable side effects appear, the carmustine therapy must be terminated.

4.3 Contraindications

Carmustine Raz 100mg should not be given to individuals who:

- have demonstrated a previous hypersensitivity to the active substance (carmustine), to other nitrosoureas or to any of the excipients listed in section 6.1
- suffer from decreased circulating platelets, leucocytes or erythrocytes either from previous chemotherapy or other causes.
- higher degree of renal impairment.
- Pregnancy and lactation (see section 4.6).

4.4 Special warnings and precautions for use

Carmustine should be used only by physicians with specific experience in the field of chemotherapy.

Myelosuppression
Delayed and cumulative bone marrow depression (especially thrombocytopenia and leukopenia) that can lead to bleeding and severe infections in patients already at risk is a common and severe toxic side effect of carmustine. Hematologic parameters (leukocytes, granulocytes, hemoglobin, platelets) should be checked prior to initiation of therapy and monitored regularly during therapy until at least 6 weeks after administration of a dose (see section 4.2). Repeated doses of carmustine should not be given more frequently than every 6 weeks.

The most common and dose-limiting adverse reaction is reversible and delayed-onset myelosuppression, which usually occurs after 4 to 6 weeks and whose severity depends on the dose. The myelosuppressive effect of carmustine is cumulative.

The lowest platelet count is observed after 4 to 5 weeks, and the lowest leukocyte count is observed 5 to 6 weeks after the start of treatment. Thrombocytopenia is generally more severe than leukocytopenia, but both side effects may be dose-limiting.

Monitoring Organ Functions
In addition, hepatic, renal, and pulmonary functions should be assessed prior to treatment and monitored regularly during therapy (see Section 4.8).
Intra-arterial administration
I.a. tolerability has not been evaluated. Severe tissue damage is to be expected in case of accidental i.a. administration.

Direct application of carmustine into the carotid artery should be considered experimental and has been associated with ocular toxicity.

Pulmonary Toxicity

Pulmonary toxicity has been observed in up to 30% of patients. Early-onset pulmonary toxicity (within 3 years of treatment) resulted in pulmonary infiltrates and/or pulmonary fibrosis, which in some cases was fatal. Patients ranged in age from 22 months to 72 years. Risk factors included smoking, respiratory disease, existing radiographic abnormalities, sequential or concurrent chest irradiation, and combination with other agents that may cause lung injury. The incidence of adverse reactions is likely dose-dependent. Cumulative doses of 1200-1500 mg/m^2 have been associated with an increased likelihood of pulmonary fibrosis. Spirometry (FVC, DLCO) should be performed regularly during treatment. Patients who have a baseline spirometry value of <70% of the expected forced expiratory vital capacity (FVC) or carbon monoxide diffusing capacity (DLCO) are particularly at risk.

Cases of very late-onset pulmonary fibrosis (up to 17 years after treatment) have been observed in patients who received carmustine in childhood or adolescence.

A long-term follow-up of 17 patients who survived childhood brain tumors showed that 8 of them died of pulmonary fibrosis. Two of these 8 deaths occurred within the first 3 years of treatment and 6 within 8-13 years of treatment. The mean age (at the time of treatment) of the patients who died was 2.5 years (1-12 years) and the mean age of the long-term survivors was 10 years (5-16 years). All patients younger than 5 years at the time of treatment died of pulmonary fibrosis. Neither the carmustine dose nor additional administration of vincristine or spinal irradiation affected the fatal outcome.

Pulmonary fibrosis was found in all remaining survivors available for followup. The risk-benefit ratio of carmustine therapy must be carefully weighed because of the high risk of pulmonary toxicity.

Renal Toxicity

Renal changes with decrease in renal size, progressive azotemia, and renal failure have been observed after high-cumulative doses and after long-term treatment with carmustine and related nitrosoureas.

Liver Toxicity

Hepatic necrosis may occur after administration of doses higher than those recommended in the dosing instructions.

High-dose therapy

High-dose therapy with carmustine increases the risk and severity of infections, cardiac, hepatic, gastrointestinal, and renal toxicity, as well as nervous system disorders and electrolyte disturbances (hypokalemia, hypomagnesemia, and hypophosphatemia).

Comorbidities and poor disease status

Patients with comorbidities and poorer disease status are at higher risk for adverse events. This is especially important for elderly patients.

Local Toxicity
Reactions at the site of administration may occur during administration of carmustine (see section 4.8). Considering the possibility of extravasation, close monitoring of the infusion site is recommended due to possible infiltration during administration. A specific method for managing extravasation is not currently known.
Accidental contact of the reconstituted infusion solution with the skin has resulted in burns and excessive pigmentation in the affected areas.
Local soft tissue toxicity resulting from extravasation of carmustine has been reported. Infiltration of carmustine may cause swelling, pain, erythema, burning, and skin necrosis.

Important information about other components:
Ethanol
This drug contains 0.57% ethanol (alcohol) by volume, or up to 7.68 g per dose. This is equivalent to 11.32 ml of beer or 4.72 ml of wine per dose. These amounts are derived from a calculated example of 320 mg carmustine (200 mg/m^2 BSA for 1.6 m^2) dissolved in 9.6 ml (sterile absolute ethanol) and a final infusion volume of 1696 ml (see Section 6.6). Health risk for patients suffering from alcoholism. Should be considered in pregnant or lactating women and in children and patients at increased risk due to liver disease or epilepsy. The amount of alcohol in this medicine may affect the effectiveness of other medicines. The amount of alcohol in this medicine may impair the ability to drive and operate machinery.

4.5 Interaction with other medicinal products and other forms of interaction

In combination with:

- phenytoin – reduced activity of antiepileptic medicinal products must be reckoned in the concomitant use with chemotherapeutic medicinal products
- cimetidine – the concomitant use leads to delayed, major, suspected, increased carmustine toxic effect (due to the inhibition of carmustine metabolism)
- digoxin – the concomitant use leads to delayed, moderate, suspected, decreased effect of digoxin (due to the decreased digoxin absorption)
- melphalan – the concomitant use leads to increased risk of pulmonary toxicity

4.6 Fertility, Pregnancy and lactation

Carmustine should not normally be administered to patients who are pregnant or mothers who are breast-feeding. Male patients should be advised to use adequate contraceptive measures during the treatment with carmustine for at least 6 months.

Pregnancy
Safe use in pregnancy has not been established and therefore the benefit to risk of toxicity must be carefully weighed. Carmustine is embryotoxic in rats and rabbits and teratogenic in rats when given in doses equivalent to the human dose. If this drug is used during pregnancy, or if the patient becomes pregnant while taking (receiving) this drug, the patient should be apprised of the potential hazard to the fetus. Women of childbearing potential should be advised to avoid becoming pregnant.

Breast-feeding
It is not known whether carmustine or its metabolites excrete in the mother´s milk. Breast-feeding should not be permitted during the treatment.

4.7 Effects on ability to drive and use machines

No studies have been undertaken on the consequences the medicine on the competency to drive and the ability to operate machines. However the possibility will have to be taken into consideration, that the alcohol quantity in these pharmaceutical medicines can impair the competency to drive and the ability to operate machines.

4.8 Undesirable effects

The table includes adverse events that were presented during drug treatment but may not necessarily have a causal relationship with the drug. Because clinical trials are conducted under very specific conditions, the adverse event rates observed may not reflect the rates observed in clinical practice. Adverse events are generally included if they were reported in more than 1% of patients in the product monograph or pivotal trials, and/or determined to be clinically important. When placebo-controlled trials are available, adverse events are included if the incidence is ≥ 5% higher in the treatment group.
High dose is defined as >200 mg/m^2
The following table includes adverse effects of carmustine divided by groups according to MedDRA terminology with frequency of occurrence: very common (≥ 1/10); common (≥1/100 to <1/10); uncommon (≥1/1,000 to <1/100); rare (≥1/10,000 to < 1/1,000); very rare (<1/10,000), not known (frequency cannot be estimated from the available data):

MedDRA system organ class	**Frequency**	**Adverse effects**
		Clinically important side effects are in *italics*
Infections and Infestations	Not known	Opportunistic infections (including fatal outcome)
Neoplasms benign, malignant and unspecified (including cysts and polyps)	Common	Acute leukemias, bone marrow dysplasias; following long-term use.
	Not known	Secondary malignancies
Blood and lymphatic system disorders	Common	Anaemia.
	Very common	*Myelosuppression; onset 7-14 days, nadir 21-35 days, recovery 42-56 days; cumulative,*

MedDRA system organ class	**Frequency**	**Adverse effects**
		Clinically important side effects are in *italics*
		dose related, delayed and often biphasic.
Immune system disorders	Not known	Allergic reaction
Metabolism and nutrition disorders	Not known	Electrolyte disorders (hypokalaemia, hypomagnesaemia, and hypophosphataemia)
Nervous system disorders	Very common	Ataxia, dizziness, headache.
	Common	Encephalopathy (high-dose therapy and dose-limiting).
	Not known	Muscular pain, status epilepticus, seizure, grand mal seizure.
Eye disorders	Very common	Ocular toxicities, transient conjunctival flushing and blurred vision; retinal haemorrhages.
	Rare	Neuroretinitis
Cardiac disorders	Very common	Hypotension, due to alcohol content of diluent (high-dose therapy)
	Not known	Tachycardia, chest pain
Vascular disorders	Very common	Phlebitis.
	Rare	Veno-occlusive disease (high-dose therapy).
Respiratory, thoracic and mediastinal disorders	Very common	*Pulmonary toxicity[1],interstitial fibrosis (with prolonged therapy and cumulative dose > 1400 mg/m^2) Pneumonitis (for doses >450mg/m^2).*
	Rare	*Interstitial fibrosis (with lower doses).*
Gastrointestinal disorders	Very common	*emetogenic potential: >250 mg/m^2 high; ≦250 mg/m^2 high-moderate*
		Nausea and vomiting, severe; begins within 2-4 h of administration and lasts for 4-6 h.
	Common	Anorexia, constipation, diarrhoea, stomatitis.
	Rare	Bleeding in the gastrointestinal tract
	Not known	Neutropenic enterocolitis
Hepatobiliary disorders	Common	Hepatotoxicity, reversible, delayed up to 60 days after administration (high-dose therapy and dose-limiting), manifested by: - bilirubin, reversible increase - alkaline phosphatase, reversible increase - SGOT, reversible increase.
Skin and subcutaneous tissue disorders	Not known	*extravasation hazard: vesicant*
	Very common	Dermatitis with topical use improves with reduced concentration of compounded product, hyperpigmentation, transient, with accidental skin contact.
	Common	Alopecia, flushing (due to alcohol content of diluent; increased with administration times <1-2 h), injection site reaction.
Renal and urinary disorders	Rare	*Renal toxicity (for cumulative doses <1,000 mg/m^2).*

Reproductive system and breast disorders	Rare	Gynecomastia.
	Not known	Infertility, teratogenesis.
General disorders and administration site conditions	Very rare	Thrombophlebitis

[1]Pulmonary toxicity is also manifested as pneumonitis and interstitial lung disease in post- marketing experience

Reporting of suspected adverse reactions
Reporting suspected adverse reactions after authorization of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Any suspected adverse events should be reported to the Ministry of Health according to the National Regulation by using an online form: https://sideeffects.health.gov.il

4.9 Overdose

The main symptom of intoxication is myelosuppression. In addition, the following serious side effects may occur:
Liver necrosis, interstitial pneumonitis, encephalomyelitis.

A specialized antidote is not available.

5 PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic Group: Antineoplastic medicine, alkylating agent, nitrosourea
ATC-Code: L01AD01

Carmustine alkylates DNA and RNA, has also been shown to inhibit several enzymes by carbamoylation of amino acids in proteins. It is thought that the antineoplastic and toxic activities of carmustine may be due to metabolites.

5.2 Pharmacokinetic properties

Distribution
Intravenously administered carmustine is rapidly degraded, with no drug intact detectable after 15 minutes. Because of the good lipid solubility and the lack of ionization at the physiological pH, carmustine is very well transferred through the blood-brain barrier. Levels of radioactivity in the CSF are at least 50% higher than those measured concurrently in plasma.
The kinetic of carmustine in humans is characterized by a two-chamber model. After the intravenous infusion over 1 hour, the carmustine-plasma level drops in a biphasic manner. The half life α accounts to 1-4 minutes and the half life β accounts to 18-69 minutes.

Metabolism

It is presumed that the metabolites of carmustine causes its antineoplastic and toxic activity.

Elimination

Approximately 60-70% of a total dose is excreted in the urine in 96 hours and about 10% as respiratory CO_2. The fate of remainder is undetermined.

5.3 Preclinical safety data

Carmustine was embryotoxic and teratogenic in rats and embryotoxic in rabbits at dose levels equivalent to the human dose. Carmustine affected the fertlility of male rats at doses higher than the human dose. Carmustine, at clinically relevant dose levels, was carcinogenic in rats and mice.

6 PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Dehydrated Alcohol.

6.2 Incompatibilities

Compatibility/ Incompatibility with Containers

The intravenous solution is unstable in polyvinyl chloride container. The carmustine solution can be administered from the glass bottles or polypropylene container only.

The pharmaceutical medicine should be used based on the instructions in Section 6.6 and not mixed up with other pharmaceutical medicines.

6.3 Shelf life

The expiry date of the product is indicated on the packaging material.

After reconstitution as recommended, Carmustine RAZ 100mg is stable for 24 hours under refrigeration (2°C - 8°C) in glass container. Protect from light.

The reconstituted solution further diluted with 500 ml sodium chloride for injection or 5% glucose for injection, in glass or polypropylene containers, results in a solution which should be utilized within 4 hours at room temperature and be protected from light. These solutions are also stable for 24 hours under refrigeration (2-8°C) and an additional 6 hours at room temperature, protected from light.
Taking into consideration the microbial aspect, it is advised to be used immediately after dilution.

6.4 Special precautions for storage

Store in a refrigerator (2^0C–8^0C).
The original package should be protected from light.
The dry frozen product does not contain any preservatives and is suitable only for one use.

There can be physical appearances of sharp flakes in the unopened vial as far as rigid mass, however without any decomposition of carmustine. The storage of carmustine at 27°C or higher temperature can lead to liquefaction of the substance, since carmustine has a low melting point (ca. 30.5°C to 32.0°C).

An indication of the decomposition is the appearance of an oil film at the bottom of the vial. This medicine should not be used any further. When you are not clear about the fact whether the product is adequately cooled, then you should immediately inspect each and every vial in the carton. For verification, hold the vial in bright light. Carmustine Raz 100mg appears with small quantities of dried flakes or dried rigid mass.

6.5 Nature and contents of container

Powder: Type I amber glass vial (30 ml) sealed with a dark grey bromobutyl lyo rubber stopper and aluminium seal having polypropylene cap.

Diluent: Type I glass vial (5 ml) sealed with a grey bromobutyl rubber stopper with an aluminium seal having polypropylene cap.

6.6 Special precautions for disposal

IMPORTANT NOTE: The lyophilized dosage formulation contains no preservative and is not intended as multiple dose vial. Reconstitution and further dilutions should be carried out under aseptic conditions.

Preparation of intravenous solution:
Dissolve Carmustine Raz 100mg with 3 ml of the supplied sterile diluent and then aseptically add 27 ml of sterile water for injection to the alcohol solution. Each ml of resulting solution will contain 3.3 mg of carmustine in 10% ethanol and has a pH of 5.6 to 6.0.

Reconstitution as recommended results in a clear colourless to yellowish solution which has to be further diluted to 500 ml sodium chloride for injection, or 5% glucose for injection. The reconstituted solution must be given intravenously and should be administered by I.V. drip over one to two hour period. Injection of Carmustine Raz 100mg over shorter periods of time may produce intense pain and burning at the site of injection.

NOTE: Reconstituted vials stored under refrigeration should be examined for crystal formation prior to use. If crystals are observed, they may be redissolved by warming the vial to room temperature with agitation.

Carmustine has a low melting point (approximately 30.5-32.0^{o}C or 86.9-89.6^{o}F). Exposure of this drug to this temperature or above will cause the drug to liquefy and appear as an oil film in the bottom of the vials. This is a sign of decomposition and vials should be discarded.

Guidelines for the safe handling of the antineoplastic agents:

1. Trained personnel should reconstitute the drug.
2. This should be performed in a designated area.
3. Adequate protective gloves should be worn.
4. Precautions should be taken to avoid the drug accidentally coming into contact with eyes. In the event of contact with the eyes, flush with copious amount of water and/or saline.
5. The cytotoxic preparation should not be handled by pregnant staff.
6. Adequate care and precaution should be taken in the disposal of items (syringes, needles etc.) used to reconstitute cytotoxic drugs. Excess material and body waste may be disposed of by placing in double sealed polythene bags and incinerating at a temperature of 1,000^{o}C. Liquid waste may be flushed with copious amounts of water.
7. The work surface should be covered with disposable plastic-backed absorbent paper.
8. Use Luer-Lock fittings on all syringes and sets. Large bore needles are recommended to minimise pressure and the possible formation of aerosols. The latter may also be reduce by the use of a venting needle.
9. Any unused product or waste material should be disposed of in accordance with local requirements for biohazardous waste.

7 **Marketing authorization holder** and importer

RAZ PHARMACEUTICS LTD., 31 Gesher haetz St., Industrial Park, Emek Hefer, Israel

8 MARKETING AUTHORISATION NUMBER(S)

162-56-35145-00

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