

## 1. NAME OF THE MEDICINAL PRODUCT

Berinert 2000  
2000 IU  
Powder and solvent for solution for injection

Berinert 3000  
3000 IU  
Powder and solvent for solution for injection.

## 2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Active substance: human C1-esterase inhibitor (from human plasma) subcutaneous (s.c.)

Berinert 2000 contains 2000 IU per injection vial.

Berinert 3000 contains 3000 IU per injection vial.

The potency of human C1-esterase inhibitor is expressed in International Units (IU), which are related to the current WHO Standard for C1-esterase inhibitor products.

Berinert 2000 contains 500 IU/ml human C1-esterase inhibitor after reconstitution with 4 ml water for injections.

Berinert 3000 contains 500 IU/ml human C1-esterase inhibitor after reconstitution with 5.6 ml water for injections.

The total protein content of the reconstituted solution is 65 mg/ml.

Excipients with known effect:

Sodium up to 486 mg (approximately 21 mmol) per 100 ml solution.

For the full list of excipients, see section 6.1.

## 3. PHARMACEUTICAL FORM

Berinert 2000  
Powder and solvent for solution for injection

Berinert 3000  
Powder and solvent for solution for injection.

White Powder.  
Clear, colourless Solvent.

## **4. CLINICAL PARTICULARS**

### **4.1 Therapeutic indications**

Berinert for subcutaneous injection is indicated for prevention of recurrent Hereditary Angioedema (HAE) attacks in adolescent and adult patients with C1-esterase inhibitor deficiency.

### **4.2 Posology and method of administration**

Berinert is intended for self-administration by subcutaneous injection. The patient or care giver should be trained on how to administer Berinert as needed.

#### Posology

The recommended dose of Berinert s.c. is 60 IU/kg body weight twice weekly (every 3-4 days)

#### **Paediatric population**

Posology in adolescents is the same as in adults.

#### Method of administration

Subcutaneous injection only

For instructions on reconstitution of the medicinal product before administration see section 6.6.

The suggested site for the subcutaneous injection of Berinert is the abdominal area. In the clinical trials, Berinert was injected into a single site.

The reconstituted preparation should be administered by subcutaneous injection at a rate tolerated by the patient.

### **4.3 Contraindications**

Individuals who have experienced life-threatening hypersensitivity reactions, including anaphylaxis, to C1-INH preparations or to any of the excipients listed in section 6.1.

### **4.4 Special warnings and precautions for use**

#### Traceability

In order to improve the traceability of biological medicinal products, the name and the batch number of the administered product should be clearly recorded.

### Hypersensitivity reactions

If severe allergic reactions occur, the administration of Berinert must be stopped immediately (e.g. discontinue injection) and appropriate medical care must be initiated.

In case of an acute HAE attack, individualized treatment should be initiated.

### Thromboembolic events (TEE)

Thrombosis has occurred in treatment attempts with high doses of C1-INH i.v. for prophylaxis or therapy of capillary leak syndrome before, during or after cardiac surgery under extracorporeal circulation (unlicensed indication and dose). At the recommended s.c. doses, a causal relationship between TEEs and the use of C1-INH concentrate has not been established.

### Virus safety

Standard measures to prevent infections resulting from the use of medicinal products prepared from human blood or plasma include selection of donors, screening of individual donations and plasma pools for specific markers of infection and the inclusion of effective manufacturing steps for the inactivation/ removal of viruses. Despite this, when medicinal products prepared from human blood or plasma are administered, the possibility of transmitting infective agents cannot be totally excluded. This also applies to unknown or emerging viruses and other pathogens.

The measures taken are considered effective for enveloped viruses such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and for the non-enveloped viruses HAV and parvovirus B19.

Appropriate vaccination (hepatitis A and B) should be generally considered for patients in regular/repeated receipt of human plasma-derived products.

Berinert 2000 IU contains less than 1 mmol sodium (23mg) per vial, that is to say essentially „sodium-free“.

Berinert 3000 IU contains up to 29 mg sodium per vial, equivalent to 1.5 % of the WHO recommended maximum daily intake of 2 g sodium for an adult.

## **4.5 Interaction with other medicinal products and other forms of interaction**

No interaction studies have been performed.

## 4.6 Fertility, pregnancy and lactation

### Pregnancy

There are limited data that suggest no increased risk from the use of human C1-esterase inhibitor products in pregnant women. Human C1-esterase inhibitor is a physiological component of human plasma. No studies on reproduction and developmental toxicity have been performed with Berinert in animals. No adverse effects on fertility, pre- and postnatal development are expected in humans.

In three studies, which included 344 patients, data from 36 women (50 pregnancies) were collected and no adverse events were associated with C1-INH treatment before, during, or after pregnancy and women delivered healthy babies.

### Breastfeeding

There is no information regarding the excretion of Berinert in human milk, the effect on the breastfed infant, or the effects on milk production. The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for Berinert and any potential adverse effects on the breastfed infant from Berinert or from the underlying maternal condition.

### Fertility

Human C1-esterase inhibitor is a physiological component of human plasma. No studies on reproduction and developmental toxicity have been performed with Berinert in animals.

## 4.7 Effects on ability to drive and use machines

Berinert has no or negligible influence on the ability to drive and use machines.

## 4.8 Undesirable effects

Adverse reactions were collected from Study 3001, the pivotal phase 3 study in patients (n= 86) with HAE who received Berinert subcutaneously. Eligible patients were also able to participate in an open-label extension study (Study 3002) for up to 140 weeks (n= 126). The frequency of adverse reactions is based on events related to Berinert. It is estimated on a per-patient basis and categorised as:

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	( $< 1/10,000$ )

MedDRA System Organ Class	Adverse Reaction	Frequency
Infections and infestations	Nasopharyngitis	Very common
Immune system disorders	Hypersensitivity (Hypersensitivity, Pruritus, Rash, and Urticaria)	Common
Nervous system disorders	Dizziness	Common
General disorders and administration site conditions	Injection site reactions <sup>a</sup>	Very common
<sup>a</sup> Injection site bruising, Injection site coldness, Injection site discharge, Injection site erythema, Injection site haematoma, Injection site haemorrhage, Injection site induration, Injection site oedema, Injection site pain, Injection site pruritus, Injection site rash, Injection site reaction, Injection site scar, Injection site swelling, Injection site urticaria, Injection site warmth.		

#### Paediatric population

The safety profile of Berinert was evaluated in a subgroup of eleven patients, 8 to < 17 years of age, in both studies (Study 3001, Study 3002) and was consistent with overall safety results.

#### Other special populations

##### Elderly population

The safety profile of Berinert was evaluated in a subgroup of ten patients, 65 to 72 years of age, in both studies (Study 3001, Study 3002) and was consistent with overall safety results.

For safety with respect to transmissible agents, see section 4.4.

#### 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 national reporting system listed in Appendix V.

## **4.9 Overdose**

No case of overdose has been reported. Doses corresponding to up to 117 IU/kg s.c. have been administered twice weekly in a fixed-dose clinical study and were well tolerated.

## **5. PHARMACOLOGICAL PROPERTIES**

### **5.1 Pharmacodynamic properties**

Pharmacotherapeutic group: Other haematological agents, Drugs used in hereditary angioedema: C1-inhibitor, plasma derived  
ATC code: B06AC01

C1-esterase inhibitor is a plasma glycoprotein with a molecular weight of 105 kD and a carbohydrate moiety of 40 %. Its concentration in human plasma ranges around 240 mg/l. Besides its occurrence in human plasma, also the placenta, the liver cells, monocytes and platelets contain C1-esterase inhibitor.

C1-esterase inhibitor belongs to the serine-protease-inhibitor-(serpin)-system of human plasma as do also other proteins like antithrombin III, alpha-2-antiplasmin, alpha-1-antitrypsin and others.

#### Mechanism of action

Under physiological conditions C1-esterase inhibitor blocks the classical pathway of the complement system by inactivating the enzymatic active components C1s and C1r. The active enzyme forms a complex with the inhibitor in a stoichiometry of 1:1.

Furthermore, C1-esterase inhibitor represents the most important inhibitor of the contact activation of coagulation by inhibiting factor XIIa and its fragments. In addition, it serves, besides alpha-2-macroglobulin, as the main inhibitor of plasma kallikrein.

The therapeutic effect of Berinert in hereditary angioedema is induced by the substitution of the deficient C1-esterase inhibitor activity.

#### Clinical efficacy and safety

The efficacy and safety of Berinert for routine prophylaxis to prevent HAE attacks were demonstrated in a multicentre, randomized, double-blind, placebo-controlled, crossover study (Study 3001). The study assessed 90 adult and adolescent subjects with symptomatic HAE type I or II. The median (range) age of subjects was 40 (12 to 72) years; 60 subjects were female and 30 subjects were male. Subjects were randomized to receive either 60 IU/kg or 40 IU/kg Berinert in one 16-week treatment period and placebo in the other 16-week treatment period. Patients self-administered Berinert or placebo subcutaneously 2 times per week. Efficacy was evaluated for the last 14 weeks of each treatment period. Eligible patients were also able to participate in an open-label extension study for up to 140 weeks (Study 3002). Approximately half of the subjects enrolled in the extension study participated in Study 3001 (64/126, 50.8%), which contributed to the similarities between study populations.

#### Study 3001:

Twice per week S.C. doses of 60 IU/kg or 40 IU/kg Berinert resulted in a significant difference in the time-normalized number of HAE attacks (the rate of attacks) relative to placebo (Table 1). The time normalized number of HAE attacks in subjects dosed with 60 IU/kg was 0.52 attacks per month compared to 4.03 attacks per month while receiving

placebo ( $p < 0.001$ ). The time normalized number of HAE attacks in subjects dosed with 40 IU/kg was 1.19 attacks per month compared to 3.61 attacks per month while receiving placebo ( $p < 0.001$ ).

**Table 1. Time-normalized Number of HAE Attacks (Number/Month)**

	60 IU/kg Treatment Sequences (N = 45)		40 IU/kg Treatment Sequences (N = 45)	
	PRODUCT	Placebo	PRODUCT	Placebo
n	43	42	43	44
Mean (SD)	0.5 (0.8)	4.0 (2.3)	1.2 (2.3)	3.6 (2.1)
Min, Max	0.0, 3.1	0.6, 11.3	0.0, 12.5	0.0, 8.9
Median	0.3	3.8	0.3	3.8
LS Mean (SE)*	0.5 (0.3)	4.0 (0.3)	1.2 (0.3)	3.6 (0.3)
95% CI for LS Mean*	(0.0, 1.0)	(3.5, 4.6)	(0.5, 1.9)	(3, 4.3)
<b>Treatment difference (within-subjects)</b>	<b>60 IU/kg – Placebo</b>		<b>40 IU/kg – Placebo</b>	
LS Mean* (95% CI)	-3.5 (-4.2, -2.8)		-2.4 (-3.4, -1.5)	
p-value*	< 0.001		< 0.001	

CI = confidence interval; HAE = hereditary angioedema; N = number of randomized subjects; n = number of subjects with data; LS = Least squares.

\* From a mixed model.

The median (25th, 75th percentile) percentage reduction in the time-normalized number of HAE attacks relative to placebo was 95% (79, 100) on 60 IU/kg and 89% (70, 100) on 40 IU/kg Berinert among subjects with evaluable data in both treatment periods.

The percentage of responders (95% CI) with a  $\geq 50\%$  reduction in the time-normalized number of HAE attacks on Berinert relative to placebo was 83% (73%, 90%). Ninety percent (90%) of subjects on 60 IU/kg responded to treatment and 76% of subjects on 40 IU/kg responded to treatment.

Seventy-one percent (71%) of subjects on 60 IU/kg and 53% of subjects on 40 IU/kg had  $\geq 1$  HAE attack per 4 week period on placebo and  $< 1$  HAE attack per 4 week period on Berinert.

A total of 40% of subjects on 60 IU/kg and 38% of subjects on 40 IU/kg were attack-free, and the median rate of HAE attacks per month was 0.3 on both doses.

Berinert resulted in a significant difference in the time-normalized number of uses of rescue medication (the rate of rescue medication use) relative to placebo. A dose of 60 IU/kg resulted in a mean rate of rescue medication of 0.3 uses per month, compared to 3.9 uses per month with placebo. A dose of 40 IU/kg resulted in a mean rate of rescue medication use of 1.1 uses per month, compared to 5.6 uses per month with placebo.

#### Study 3002:

The long-term safety and efficacy of Berinert for routine prophylaxis to prevent HAE attacks were demonstrated in an open-label, randomized, parallel-arm study. The study assessed 126 adult and paediatric subjects with symptomatic HAE type I or II, consisting of 64 roll-over patients from study 3001 and 62 non-rollover patients. The median (range) age of subjects was 41.0 (8-72) years. Patients with a monthly attack rate of 4.3 in 3 months before entry in the study were enrolled and treated for a mean of 1.5 years; 44 patients (34.9%) had more than 2 years of exposure. Mean steady-state C1-INH functional activity increased to 52.0% with 40 IU/kg and 66.6% with 60 IU/kg. Incidence of adverse events was low and similar in both dose groups (11.3 and 8.5 events per patient-year for 40 IU/kg and 60 IU/kg, respectively).

The mean (SD) time-normalized number of HAE attacks was 0.45 (0.737) attacks per month for 40 IU and 0.45 (0.858) attacks per month for 60 IU.

The percentage of responders (95 % CI) with a  $\geq 50$  % reduction in the time-normalized number of HAE attacks on Berinert relative to the time-normalized number of HAE attacks used to qualify for participation in Study 3002 was 93.5 % (84.6 %, 97.5 %) in the 40 IU/kg treatment arm and 91.7 % (81.9 %, 96.4 %) in the 60 IU/kg treatment arm.

The percentage of subjects with a time-normalized HAE attack frequency of  $< 1$  HAE attack per 4-week period was 79.4 % for 40 IU/kg and 85.7 % for 60 IU/kg.

The percentage of HAE attack-free subjects was 34.9 % for 40 IU/kg and 44.4 % for 60 IU/kg (throughout the study duration with the maximum duration of exposure of  $> 2.5$  years). Of 23 patients receiving 60 IU/kg for more than 2 years, 19 (83 %) were attack-free during months 25 to 30 of treatment.

The mean time-normalized number of uses of rescue medication was 0.26 (0.572) use per month for 40 IU/kg and 0.31 (0.804) uses per month for 60 IU/kg.

#### Paediatric population

The safety and effectiveness of Berinert were evaluated in a subgroup of 11 patients 8 to  $< 17$  years of age, in the randomized, double-blind, placebo-controlled, crossover, routine prophylaxis trial (Study 3001) and the randomized, open-label, active treatment-controlled study (Study 3002). Results of subgroup analysis by age were consistent with overall study results.



## 5.2 Pharmacokinetic properties

The pharmacokinetic (PK) characteristics of Berinert subcutaneous were primarily described using population PK methods on pooled data from 3 clinical trials in healthy subjects and HAE patients.

### Absorption

Following twice weekly subcutaneous dosing, Berinert is slowly absorbed, with a median (95% CI) time to peak concentration ( $t_{max}$ ) of approximately 59 hours (23, 134 hours). Based on a median (95% CI) apparent plasma half-life of 69 hours (24, 250 hours), steady state for C1-INH is expected within 3 weeks of dosing. A mean (95% CI) steady state trough functional C1-INH of 48% (25.1 102%) is expected after twice weekly s.c. administration of 60 IU/kg Berinert. The mean (95% CI) relative bioavailability (F) of Berinert after s.c. administration was estimated to be approximately 43% (35.2, 50.2%).

### Distribution and Elimination

The population mean (95% CI) clearance and apparent volume of distribution of Berinert were estimated to be approximately 83 mL/hr (72.7, 94.2 mL/hr) and 4.33 L (3.51, 5.15 L). C1-INH clearance was found to be positively correlated with total body weight. The steady state PK of s.c. Berinert was found to be independent of dose between 20-80 IU/kg in HAE subjects.

Studies have not been conducted to evaluate the PK of C1 INH in specific patient populations stratified by gender, race, age, or the presence of renal or hepatic impairment. The population analysis, evaluating age (8 to 72 years), was found not to influence the PK of C1-INH.

## 5.3 Preclinical safety data

Non-clinical data following intravenous and or subcutaneous administration reveal no special hazard for humans based on conventional studies of safety pharmacology, single and repeat dose toxicity, local tolerability and thrombogenicity.

No investigations on carcinogenicity and reproductive toxicology have been conducted.

## 6. PHARMACEUTICAL PARTICULARS

### 6.1 List of excipients

#### Powder:

Glycine  
Sodium chloride  
Sodium citrate

Solvent:

Water for injections

## 6.2 Incompatibilities

In the absence of compatibility studies, this medicinal product must not be mixed with other medicinal products and diluents.

## 6.3 Shelf life

36 months

After reconstitution the physico-chemical stability has been demonstrated for 48 hours at room temperature (max. 30°C). From a microbiological point of view and as Berinert contains no preservative, the reconstituted product should be used immediately. If it is not administered immediately, storage shall not exceed 8 hours at room temperature. The reconstituted product should only be stored in the **vial**.

## 6.4 Special precautions for storage

Do not store above 30 °C.

Do not freeze.

Keep the vial in the outer carton in order to protect from light.

For storage conditions after reconstitution of the medicinal product, see section 6.3.

## 6.5 Nature and contents of container

### Immediate containers

- Berinert 2000: Powder (2000 IU) in a vial (Type II glass) with a stopper (bromobutyl rubber), blue seal (aluminium) and grey flip-off cap (plastic).  
4 ml of solvent in a vial (Type I glass) with a stopper (chlorobutyl or bromobutyl rubber), blue seal (aluminium) and grey flip-off cap (plastic).
- Berinert 3000: Powder (3000 IU) in a vial (Type II glass) with a stopper (bromobutyl rubber), blue seal (aluminium) and lemon flip-off cap (plastic).  
5.6 ml of solvent in a vial (Type I glass) with a stopper (chlorobutyl or bromobutyl rubber), blue seal (aluminium) and lime flip-off cap (plastic).

Presentations:

Box containing:

1 vial with powder

1 solvent vial (Berinert 2000: 4 ml, Berinert 3000: 5.6 ml)

1 filter transfer device 20/20

Administration set (inner box):

- 1 disposable syringe (Berinert 2000: 5 ml, Berinert 3000: 10 ml)
- 1 hypodermic needle
- 1 subcutaneous injection set
- 2 alcohol swabs,
- 1 plaster

Multipacks with 5 x 2000 IU and 20 x 2000 IU.  
 Multipacks with 5 x 3000 IU and 20 x 3000 IU.

Not all pack sizes may be marketed.

## 6.6 Special precautions for disposal and other handling

Any unused medicinal product or waste material should be disposed of in accordance with local requirements.

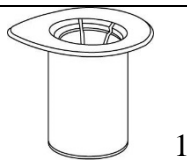
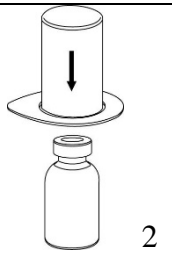
### *Method of administration*

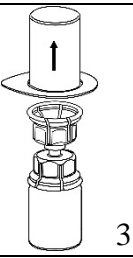
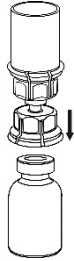
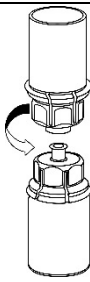


#### *General instructions*

- The reconstituted solution for Berinert should be colourless and clear to slightly opalescent.
- After filtering/withdrawal (see below) reconstituted product should be inspected visually for particulate matter and discoloration prior to administration.
- Do not use solutions that are cloudy or have deposits.
- Reconstitution and withdrawal must be carried out under aseptic conditions. Use the syringe provided with the product.

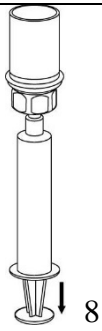

#### *Reconstitution*

Bring the solvent to room temperature. Ensure product and solvent vial flip caps are removed and the stoppers are treated with an antiseptic solution and allowed to dry prior to opening the Mix2Vial package.

	<p>1. Open the Mix2Vial package by peeling off the lid. Do <b>not</b> remove the Mix2Vial from the blister package!</p>
	<p>2. Place the solvent vial on an even, clean surface and hold the vial tight. Take the Mix2Vial together with the blister package and push the spike of the blue adapter end <b>straight down</b> through the solvent vial stopper.</p>

	<p>3. Carefully remove the blister package from the Mix2Vial set by holding at the rim, and pulling <b>vertically</b> upwards. Make sure that you only pull away the blister package and not the Mix2Vial set.</p>
	<p>4. Place the product vial on an even and firm surface. Invert the solvent vial with the Mix2Vial set attached and push the spike of the transparent adapter end <b>straight down</b> through the product vial stopper. The solvent will automatically flow into the product vial.</p>
	<p>5. With one hand grasp the product-side of the Mix2Vial set and with the other hand grasp the solvent-side and unscrew the set carefully counterclockwise into two pieces. Discard the solvent vial with the blue Mix2Vial adapter attached.</p>
	<p>6. Gently swirl the product vial with the transparent adapter attached until the substance is fully dissolved. Do not shake.</p>
	<p>7. Draw air into an empty, sterile syringe. Use the syringe provided with the product. While the product vial is upright, connect the syringe to the Mix2Vial's Luer Lock fitting by screwing clockwise. Inject air into the product vial.</p>

### *Withdrawal and application*

	8. While keeping the syringe plunger pressed, invert the system upside down and draw the solution into the syringe by pulling the plunger back slowly.
	9. Now that the solution has been transferred into the syringe, firmly hold on to the barrel of the syringe (keeping the syringe plunger facing down) and disconnect the transparent Mix2Vial adapter from the syringe by unscrewing counterclockwise.

### *Application*

The product can be administered using a hypodermic needle or a subcutaneous infusion kit.

## **7. MARKETING AUTHORISATION HOLDER**

CSL Behring GmbH  
Emil-von-Behring-Strasse 76  
35041 Marburg  
Germany

## **8. MARKETING AUTHORISATION NUMBER(S)**

- country specific -

## **9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION**

- country specific -

## **10. DATE OF REVISION OF THE TEXT**

October 2021