

## Part II

### Summary of Product Characteristics

#### 1 NAME OF THE MEDICINAL PRODUCT

Simvastatin ct 40 mg Film-coated Tablets.

#### 2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each tablet contains 40 mg of simvastatin.

Each tablet contains 298 mg lactose anhydrous

For a full list of excipients, see section 6.1.

#### 3 PHARMACEUTICAL FORM

Film-coated tablet.

Oblong, biconvex, white to off-white tablets with a scoreline on one side.

The tablet can be divided into equal halves.

#### 4 CLINICAL PARTICULARS

##### 4.1 Therapeutic Indications

###### Hypercholesterolaemia

Treatment of primary hypercholesterolaemia or mixed dyslipidaemia, as an adjunct to diet, when response to diet and other non-pharmacological treatments (e.g. exercise, weight reduction) is inadequate.

Treatment of homozygous familial hypercholesterolaemia as an adjunct to diet and other lipidlowering treatments (e.g. LDL apheresis) or if such treatments are not appropriate.

###### Cardiovascular prevention

Reduction of cardiovascular mortality and morbidity in patients with manifest atherosclerotic cardiovascular disease or diabetes mellitus, with either normal or increased cholesterol levels, as an adjunct to correction of other risk factors and other cardioprotective therapy (*see section 5.1*).

##### 4.2 Posology and method of administration

The dosage range is 5-80 mg/day given orally as a single dose in the evening. Adjustments of dosage, if required, should be made at intervals of not less than 4 weeks, to a maximum of 80 mg/day given as a single dose in the evening. The 80-mg dose is only recommended in patients with severe hypercholesterolaemia and high risk for cardiovascular complications.

###### Hypercholesterolaemia

The patient should be placed on a standard cholesterol-lowering diet, and should continue on this diet during treatment with *Simvastatin-CT*. The usual starting dose is 10-20 mg/day given as a single dose in the evening. Patients who require a large reduction in LDL-C (more than 45 %) may be started at 20-40 mg/day given as a single dose in the evening. Adjustments of dosage, if required, should be made as specified above.

### Homozygous familial hypercholesterolaemia

Based on the results of a controlled clinical study, the recommended dosage is *Simvastatin-CT* 40 mg/day in the evening or 80 mg/day in 3 divided doses of 20 mg, 20 mg, and an evening dose of 40 mg. *Simvastatin-CT* should be used as an adjunct to other lipid-lowering treatments (e.g., LDL apheresis) in these patients or if such treatments are unavailable.

### Cardiovascular prevention

The usual dose of *Simvastatin-CT* is 20 to 40 mg/day given as a single dose in the evening in patients at high risk of coronary heart disease (CHD, with or without hyperlipidaemia). Drug therapy can be initiated simultaneously with diet and exercise. Adjustments of dosage, if required, should be made as specified above.

### Concomitant therapy

*Simvastatin-CT* is effective alone or in combination with bile acid sequestrant. Dosing should occur either > 2 hours before or > 4 hours after administration of a bile acid sequestrant.

In patients taking ciclosporin, danazol, gemfibrozil, other fibrates (except fenofibrate) or lipid-lowering doses ( $\geq 1$  g/day) of niacin concomitantly with *Simvastatin-CT*, the dose of *Simvastatin-CT* should not exceed 10 mg/day. In patients taking amiodarone or verapamil concomitantly with *Simvastatin-CT*, the dose of *Simvastatin-CT* should not exceed 20 mg/day. (See sections 4.4 and 4.5.)

### Dosage in renal insufficiency

No modification of dosage should be necessary in patients with moderate renal insufficiency. In patients with severe renal insufficiency (creatinine clearance < 30 ml/min), dosages above 10 mg/day should be carefully considered and, if deemed necessary, implemented cautiously.

### Use in the elderly

No dosage adjustment is necessary.

### Use in children and adolescents

Efficacy and safety of use in children have not been established. Therefore *Simvastatin-CT* is not recommended for paediatric use.

## **4.3 Contraindications**

- Hypersensitivity to simvastatin or to any of the excipients.
- Active liver disease or unexplained persistent elevations of serum transaminases.
- Pregnancy and lactation (see section 4.6).
- Concomitant administration of potent CYP3A4 inhibitors (e.g. itraconazole, ketoconazole, fluconazole, posaconazole, HIV protease inhibitors [e. g. nelfinavir], erythromycin, clarithromycin, telithromycin and nefazodone) (see section 4.5).

## 4.4 Special warnings and precautions for use

### Myopathy/Rhabdomyolysis

Simvastatin, like other inhibitors of HMG-CoA reductase, occasionally causes myopathy manifested as muscle pain, tenderness or weakness with creatine kinase (CK) above ten times the upper limit of normal (ULN). Myopathy sometimes takes the form of rhabdomyolysis with or without acute renal failure secondary to myoglobinuria, and very rare fatalities have occurred. The risk of myopathy is increased by high levels of HMG-CoA reductase inhibitory activity in plasma.

As with other HMG-CoA reductase inhibitors, the risk of myopathy/rhabdomyolysis is dose related. In a clinical trial database in which 41,050 patients were treated with Simvastatin with 24,747 (approximately 60 %) treated for at least 4 years, the incidence of myopathy was approximately 0.02 %, 0.08 % and 0.53 % at 20, 40 and 80 mg/day, respectively. In these trials, patients were carefully monitored and some interacting medicinal products were excluded.

### Creatine Kinase measurement

Creatine Kinase (CK) should not be measured following strenuous exercise or in the presence of any plausible alternative cause of CK increase as this makes value interpretation difficult. If CK levels are significantly elevated at baseline ( $> 5 \times \text{ULN}$ ), levels should be re-measured within 5 to 7 days later to confirm the results.

### Before the treatment

All patients starting therapy with simvastatin, or whose dose of simvastatin is being increased, should be advised of the risk of myopathy and told to report promptly any unexplained muscle pain, tenderness or weakness.

Caution should be exercised in patients with pre-disposing factors for rhabdomyolysis. In order to establish a reference baseline value, a CK level should be measured before starting a treatment in the following situations:

- Elderly (age  $> 70$  years)
- Renal impairment
- Uncontrolled hypothyroidism
- Personal or familial history of hereditary muscular disorders
- Previous history of muscular toxicity with a statin or fibrate
- Alcohol abuse.

In such situations, the risk of treatment should be considered in relation to possible benefit, and clinical monitoring is recommended. If a patient has previously experienced a muscle disorder on a fibrate or a statin, treatment with a different member of the class should only be initiated with caution. If CK levels are significantly elevated at baseline ( $> 5 \times \text{ULN}$ ), treatment should not be started.

### Whilst on treatment

If muscle pain, weakness or cramps occur whilst a patient is receiving treatment with a statin, their CK levels should be measured. If these levels are found, in the absence of strenuous exercise, to be significantly elevated ( $> 5 \times \text{ULN}$ ), treatment should be stopped. If muscular symptoms are severe and cause daily discomfort, even if CK levels are  $< 5 \times \text{ULN}$ , treatment discontinuation may be considered. If myopathy is suspected for any other reason, treatment should be discontinued.

If symptoms resolve and CK levels return to normal, then re-introduction of the statin or introduction of an alternative statin may be considered at the lowest dose and with close monitoring.

Therapy with *Simvastatin-CT* should be temporarily stopped a few days prior to elective major surgery and when any major medical or surgical condition supervenes.

### Measures to reduce the risk of myopathy caused by medicinal product interactions (see also section 4.5)

The risk of myopathy and rhabdomyolysis is significantly increased by concomitant use of simvastatin with potent inhibitors of CYP3A4 (such as itraconazole, ketoconazole, fluconazole, posaconazole, erythromycin, clarithromycin, telithromycin, HIV protease inhibitors [e.g. nelfinavir], nefazodone), as well as gemfibrozil, ciclosporin and danazol (see section 4.2)

The risk of myopathy and rhabdomyolysis is also increased by concomitant use of other fibrates, lipid-lowering doses ( $\geq 1$  g/day) of niacin or by concomitant use of amiodarone or verapamil with higher doses of simvastatin (*see sections 4.2 and 4.5*). There is also a slight increase in risk when diltiazem is used with simvastatin 80 mg. The risk of myopathy may be increased by concomitant administration of fusidic acid with statins (*see section 4.5*).

Consequently, regarding CYP3A4 inhibitors, the use of simvastatin concomitantly with itraconazole, ketoconazole, fluconazole, posaconazole, HIV protease inhibitors (e. g. nelfinavir), erythromycin, clarithromycin, telithromycin and nefazodone is contraindicated (*see sections 4.3 and 4.5*). If treatment with itraconazole, ketoconazole, fluconazole, posaconazole, erythromycin, clarithromycin or telithromycin is unavoidable, therapy with simvastatin must be suspended during the course of treatment. Moreover, caution should be exercised when combining simvastatin with certain other less potent CYP3A4 inhibitors: ciclosporin, verapamil or diltiazem (*see sections 4.2 and 4.5*). Concomitant intake of grapefruit juice and *Simvastatin-CT* should be avoided.

The dose of *Simvastatin-CT* should not exceed 10 mg daily in patients receiving concomitant medication with danazol, ciclosporin, gemfibrozil, or lipid-lowering doses ( $\geq 1$  g/day) of niacin. The combined use of simvastatin with gemfibrozil should be avoided, unless the benefits are likely to outweigh the increased risks of this drug combination. The benefits of the combined use of simvastatin 10 mg daily with other fibrates (except fenofibrate), niacin or ciclosporin should be carefully weighed against the potential risks of these combinations. (*See sections 4.2 and 4.5.*)

Caution should be used when prescribing fenofibrate with simvastatin, as either agent can cause myopathy when given alone.

The combined use of simvastatin at doses higher than 20 mg daily with amiodarone or verapamil should be avoided unless the clinical benefit is likely to outweigh the increased risk of myopathy (*see sections 4.2 and 4.5*).

If the combination proves necessary, patients on fusidic acid and simvastatin should be closely monitored (*see section 4.5*). Temporary suspension of simvastatin treatment may be considered.

#### Hepatic effects

In clinical studies, persistent increases (to  $> 3 \times$  ULN) in serum transaminases have occurred in a few adult patients who received simvastatin. When simvastatin was interrupted or discontinued in these patients, the transaminase levels usually fell slowly to pre-treatment levels.

It is recommended that liver function tests be performed before treatment begins and thereafter when clinically indicated. Patients titrated to the 80-mg dose should receive an additional test prior to titration, 3 months after titration to the 80-mg dose, and periodically thereafter (e.g., semi-annually) for the first year of treatment. Special attention should be paid to patients who develop elevated serum transaminase levels, and in these patients, measurements should be repeated promptly and then performed more frequently. If the transaminase levels show evidence of progression, particularly if they rise to  $3 \times$  ULN and are persistent, *Simvastatin-CT* should be discontinued.

The product should be used with caution in patients who consume substantial quantities of alcohol.

As with other lipid-lowering agents, moderate ( $< 3 \times$  ULN) elevations of serum transaminases have been reported following therapy with simvastatin. These changes appeared soon after initiation of therapy with simvastatin, were often transient, were not accompanied by any symptoms and interruption of treatment was not required.

Patients with rare hereditary problems of galactose intolerance, the Lapp lactase deficiency or glucose-galactose malabsorption should not take this medicine.

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

### Pharmacodynamic interactions

#### *Interactions with lipid-lowering medicinal products that can cause myopathy when given alone*

The risk of myopathy, including rhabdomyolysis, is increased during concomitant administration with fibrates and niacin (nicotinic acid) ( $\geq 1$  g/day). Additionally, there is a pharmacokinetic interaction with gemfibrozil resulting in increased simvastatin plasma levels (*see below Pharmacokinetic interactions and sections 4.2 and 4.4*). When simvastatin and fenofibrate are given concomitantly, there is no evidence that the risk of myopathy exceeds the sum of the individual risks of each agent. Adequate pharmacovigilance and pharmacokinetic data are not available for other fibrates.

*Pharmacokinetic interactions*

Prescribing recommendations for interacting agents are summarized in the table below (*further details are provided in the text; see also sections 4.2, 4.3, and 4.4*).

Drug interactions associated with increased risk of myopathy/rhabdomyolysis

Interacting agents	Prescribing recommendations
Potent CYP3A4 inhibitors: Itraconazole Ketoconazole, Fluconazole, Posaconazole Erythromycin Clarithromycin Telithromycin HIV protease inhibitors (e. g. nelfinavir) Nefazodone	Contraindicated with Simvastatin
Gemfibrozil	Avoid but if necessary, do not exceed 10 mg simvastatin daily.
Ciclosporin Danazol Other fibrates (except fenofibrate) Niacin ( $\geq 1$ g/day)	Do not exceed 10 mg simvastatin daily
Amiodarone Verapamil	Do not exceed 20 mg simvastatin daily.
Diltiazem	Do not exceed 40 mg simvastatin daily.
Fusidic acid	Patients should be closely monitored. Temporary suspension of simvastatin treatment may be considered.
Grapefruit juice	Avoid grapefruit juice when taking simvastatin.

*Effects of other medicinal products on simvastatin*

*Interactions involving CYP3A4*

Simvastatin is a substrate of cytochrome P450 3A4. Potent inhibitors of cytochrome P450 3A4 increase the risk of myopathy and rhabdomyolysis by increasing the concentration of HMG-CoA reductase inhibitory activity in plasma during simvastatin therapy. Such inhibitors include itraconazole, ketoconazole, fluconazole, posaconazole, erythromycin, clarithromycin, telithromycin, HIV protease inhibitors (e. g. nelfinavir), and nefazodone. Concomitant administration of itraconazole resulted in a more than 10-fold increase in exposure to simvastatin acid (the active beta-hydroxyacid metabolite). Telithromycin caused an 11-fold increase in exposure to simvastatin acid.

Therefore, combination with itraconazole, ketoconazole, fluconazole, posaconazole, HIV protease inhibitors (e. g. nelfinavir), erythromycin, clarithromycin, telithromycin and nefazodone is contraindicated. If treatment with itraconazole, ketoconazole, fluconazole, posaconazole, erythromycin, clarithromycin or telithromycin is unavoidable, therapy with simvastatin must be suspended during the course of treatment. Caution should be exercised when combining simvastatin with certain other less potent CYP3A4 inhibitors: ciclosporin, verapamil or diltiazem (*see sections 4.2 and 4.4*).

*Ciclosporin*

The risk of myopathy/rhabdomyolysis is increased by concomitant administration of ciclosporin particularly with higher doses of simvastatin (*see sections 4.2 and 4.4*). Therefore, the dose of *Simvastatin-CT* should not exceed 10 mg daily in patients receiving concomitant medication with ciclosporin. Although the mechanism is not fully understood, ciclosporin increases the AUC of simvastatin acid presumably due, in part, to inhibition of CYP3A4.

*Danazol*

The risk of myopathy and rhabdomyolysis is increased by concomitant administration of danazol with higher doses of simvastatin (*see sections 4.2 and 4.4*).

*Gemfibrozil*

Gemfibrozil increases the AUC of simvastatin acid by 1.9-fold, possibly due to inhibition of the glucuronidation pathway (*see sections 4.2 and 4.4*).

*Amiodarone and verapamil*

The risk of myopathy and rhabdomyolysis is increased by concomitant administration of amiodarone or verapamil with higher doses of simvastatin (*see section 4.4*). In an ongoing clinical trial, myopathy has been reported in 6 % of patients receiving simvastatin 80 mg and amiodarone.

An analysis of the available clinical trials showed an approximately 1 % incidence of myopathy in patients receiving simvastatin 40 mg or 80 mg and verapamil. In a pharmacokinetic study, concomitant administration with verapamil resulted in a 2.3-fold increase in exposure of simvastatin acid, presumably due, in part, to inhibition of CYP3A4. Therefore, the dose of simvastatin should not exceed 20 mg daily in patients receiving concomitant medication with amiodarone or verapamil, unless the clinical benefit is likely to outweigh the increased risk of myopathy and rhabdomyolysis.

*Diltiazem*

An analysis of the available clinical trials showed a 1 % incidence of myopathy in patients receiving simvastatin 80 mg and diltiazem. The risk of myopathy in patients taking simvastatin 40 mg was not increased by concomitant diltiazem (*see section 4.4*). In a pharmacokinetic study, concomitant administration of diltiazem caused a 2.7-fold increase in exposure of simvastatin acid, presumably due to inhibition of CYP3A4. Therefore, the dose of simvastatin should not exceed 40 mg daily in patients receiving concomitant medication with diltiazem, unless the clinical benefit is likely to outweigh the increased risk of myopathy and rhabdomyolysis.

*Fusidic acid*

The risk of myopathy may be increased by concomitant administration of fusidic acid with statins, including simvastatin. Isolated cases of rhabdomyolysis have been reported with simvastatin. Temporary suspension of simvastatin treatment may be considered. If it proves necessary, patients on fusidic acid should be closely monitored (*see section 4.4*).

*Amlodipine*

In a pharmacokinetic study, concomitant administration with amlodipine resulted in a 1.4-fold increase in the peak concentration ( $C_{\max}$ ) and 1.3-fold increase in the total exposure (area under the concentration-time curve, (AUC) of the active metabolites of simvastatin without affecting its cholesterol-lowering effect. The clinical relevance of this interaction is unknown.

*Grapefruit juice*

Grapefruit juice inhibits cytochrome P450 3A4. Concomitant intake of large quantities (over 1 litre daily) of grapefruit juice and simvastatin resulted in a 7-fold increase in exposure to simvastatin acid. Intake of 240 ml of grapefruit juice in the morning and simvastatin in the evening also resulted in a 1.9-fold increase. Intake of grapefruit juice during treatment with simvastatin should therefore be avoided.

*Oral anticoagulants*

In two clinical studies, one in normal volunteers and the other in hypercholesterolaemic patients, simvastatin 20-40 mg/day modestly potentiated the effect of coumarin anticoagulants: the prothrombin time, reported as International Normalized Ratio (INR), increased from a baseline of 1.7 to 1.8 and from 2.6 to 3.4 in the volunteer and patient studies, respectively. Very rare cases of elevated INR have been reported. In patients taking coumarin anticoagulants, prothrombin time should be determined before starting simvastatin and frequently enough during early therapy to ensure that no significant alteration of prothrombin time occurs. Once a stable prothrombin time has been documented, prothrombin times can be monitored at the intervals usually recommended for patients on coumarin anticoagulants. If the dose of simvastatin is changed or discontinued, the same procedure should be repeated. Simvastatin therapy has not been associated with bleeding or with changes in prothrombin time in patients not taking anticoagulants.

*Effects of simvastatin on the pharmacokinetics of other medicinal products*

Simvastatin does not have an inhibitory effect on cytochrome P450 3A4. Therefore, simvastatin is not expected to affect plasma concentrations of substances metabolised via cytochrome P450 3A4.

## 4.6 Pregnancy and lactation

### *Pregnancy*

*Simvastatin-CT* is contraindicated during pregnancy (*see section 4.3*).

Safety in pregnant women has not been established. No controlled clinical trials with simvastatin have been conducted in pregnant women. Rare reports of congenital anomalies following intrauterine exposure to HMG-CoA reductase inhibitors have been received. However, in an analysis of approximately 200 prospectively followed pregnancies exposed during the first trimester to *Simvastatin-CT* or another closely related HMG-CoA reductase inhibitor, the incidence of congenital anomalies was comparable to that seen in the general population. This number of pregnancies was statistically sufficient to exclude a 2.5-fold or greater increase in congenital anomalies over the background incidence.

Although there is no evidence that the incidence of congenital anomalies in offspring of patients taking *Simvastatin-CT* or another closely related HMG-CoA reductase inhibitor differs from that observed in the general population, maternal treatment with *Simvastatin-CT* may reduce the foetal levels of mevalonate which is a precursor of cholesterol biosynthesis. Atherosclerosis is a chronic process, and ordinarily discontinuation of lipid-lowering medicinal products during pregnancy should have little impact on the long-term risk associated with primary hypercholesterolaemia. For these reasons, *Simvastatin-CT* must not be used in women who are pregnant, trying to become pregnant or suspect they are pregnant. Treatment with *Simvastatin-CT* must be suspended for the duration of pregnancy or until it has been determined that the woman is not pregnant. (*See section 4.3.*)

### *Lactation*

It is not known whether simvastatin or its metabolites are excreted in human milk. Because many medicinal products are excreted in human milk and because of the potential for serious adverse reactions, women taking *Simvastatin-CT* must not breast-feed their infants (*see section 4.3*).

## 4.7 Effects on ability to drive and use machines

*Simvastatin-CT* has no or negligible influence on the ability to drive and use machines. However, when driving vehicles or operating machines, it should be taken into account that dizziness has been reported rarely in post-marketing experiences.

## 4.8 Undesirable effects

The frequencies of the following adverse events, which have been reported during clinical studies and/or post-marketing use, are categorized based on an assessment of their incidence rates in large, long-term, placebo-controlled, clinical trials including HPS and 4S with 20,536 and 4,444 patients, respectively (*see section 5.1*). For HPS, only serious adverse events were recorded as well as myalgia, increases in serum transaminases and CK. For 4S, all the adverse events listed below were recorded. If the incidence rates on simvastatin were less than or similar to that of placebo in these trials, and there were similar reasonably causally related spontaneous report events, these adverse events are categorized as "rare".

In HPS (*see section 5.1*) involving 20,536 patients treated with 40 mg/day of Simvastatin (n = 10,269) or placebo (n = 10,267), the safety profiles were comparable between patients treated with Simvastatin 40 mg and patients treated with placebo over the mean 5 years of the study. Discontinuation rates due to side effects were comparable (4.8 % in patients treated with Simvastatin 40 mg compared with 5.1 % in patients treated with placebo). The incidence of myopathy was <0.1 % in patients treated with Simvastatin 40 mg. Elevated transaminases (> 3 x ULN confirmed by repeat test) occurred in 0.21 % (n = 21) of patients treated with Simvastatin 40 mg compared with 0.09 % (n = 9) of patients treated with placebo.

The frequencies of adverse events are ranked according to the following: Very common (> 1/10), Common ( $\geq$  1/100, < 1/10), Uncommon ( $\geq$  1/1000, < 1/100), Rare ( $\geq$  1/10,000, < 1/1000), Very Rare (< 1/10,000) including isolated reports.

### Blood and lymphatic system disorders:

*Rare:* anaemia

### Psychiatric disorders:

*Uncommon:* depression

Nervous system disorders:*Uncommon:* sleep disturbances including insomnia and nightmares, memory loss*Rare:* headache, paresthesia, dizziness, peripheral neuropathy, peripheral polyneuropathyRespiratory, thoracic and mediastinal disorders:*Very rare:* interstitial lung diseaseGastrointestinal disorders:*Rare:* constipation, abdominal pain, flatulence, dyspepsia, diarrhoea, nausea, vomiting, pancreatitisHepato-biliary disorders:*Rare:* hepatitis/jaundiceSkin and subcutaneous tissue disorders:*Rare:* rash, pruritus, alopeciaMusculoskeletal, connective tissue and bone disorders:*Rare:* myopathy, rhabdomyolysis, which can be accompanied by acute renal failure secondary to myoglobinuria (*see section 4.4*), myalgia, muscle cramps, myositis, polymyositisReproductive system and breast disorders:*Uncommon:* sexual dysfunctionGeneral disorders and administration site conditions:*Rare:* asthenia

An apparent hypersensitivity syndrome has been reported rarely which has included some of the following features: angioedema, lupus-like syndrome, polymyalgia rheumatica, dermatomyositis, vasculitis, thrombocytopenia, eosinophilia, ESR increased, arthritis and arthralgia, urticaria, photosensitivity, fever, flushing, dyspnoea and malaise.

Investigations:*Rare:* increases in serum transaminases (alanine aminotransferase, aspartate aminotransferase, gamma-glutamyl transpeptidase) (*see section 4.4 Hepatic effects*), elevated alkaline phosphatase; increase in serum CK levels (*see section 4.4*).

## 4.9 Overdose

To date, a few cases of overdosage have been reported; the maximum dose taken was 3.6 g. All patients recovered without sequelae. There is no specific treatment in the event of overdose. In this case, symptomatic and supportive measures should be adopted.

## 5 PHARMACOLOGICAL PROPERTIES

### 5.1 Pharmacodynamic properties

Pharmacotherapeutic group: HMG-CoA reductase inhibitor

ATC-Code: C10A A01

After oral ingestion, simvastatin, which is an inactive lactone, is hydrolyzed in the liver to the corresponding active beta-hydroxyacid form which has a potent activity in inhibiting HMG-CoA reductase (3 hydroxy - 3 methylglutaryl CoA reductase). This enzyme catalyses the conversion of HMG-CoA to mevalonate, an early and rate-limiting step in the biosynthesis of cholesterol.

Simvastatin has been shown to reduce both normal and elevated LDL-C concentrations. LDL is formed from very-low-density protein (VLDL) and is catabolised predominantly by the high affinity LDL receptor. The mechanism of the LDL-lowering effect of simvastatin may involve both reduction of VLDL-cholesterol (VLDL-C) concentration and induction of the LDL receptor, leading to reduced production and increased catabolism of LDL-C. Apolipoprotein B also falls substantially during treatment with simvastatin. In addition, simvastatin moderately increases HDL-C and reduces plasma TG. As a result of these changes the ratios of total- to HDL-C and LDL- to HDL-C are reduced.



### High Risk of Coronary Heart Disease (CHD) or Existing Coronary Heart Disease

In the Heart Protection Study (HPS), the effects of therapy with Simvastatin were assessed in 20,536 patients (age 40-80 years), with or without hyperlipidaemia, and with coronary heart disease, other occlusive arterial disease or diabetes mellitus. In this study, 10,269 patients were treated with Simvastatin 40 mg/day and 10,267 patients were treated with placebo for a mean duration of 5 years. At baseline, 6,793 patients (33 %) had LDL-C levels below 116 mg/dL; 5,063 patients (25 %) had levels between 116 mg/dL and 135 mg/dL; and 8,680 patients (42 %) had levels greater than 135 mg/dL.

Treatment with simvastatin 40 mg/day compared with placebo significantly reduced the risk of all cause mortality (1328 [12.9 %] for simvastatin-treated patients versus 1507 [14.7 %] for patients given placebo;  $p = 0.0003$ ), due to an 18 % reduction in coronary death rate (587 [5.7 %] versus 707 [6.9 %];  $p = 0.0005$ ; absolute risk reduction of 1.2 %). The reduction in non-vascular deaths did not reach statistical significance. Simvastatin also decreased the risk of major coronary events (a composite endpoint comprised of non-fatal MI or CHD death) by 27 % ( $p < 0.0001$ ). Simvastatin reduced the need for undergoing coronary revascularization procedures (including coronary artery bypass grafting or percutaneous transluminal coronary angioplasty) and peripheral and other non-coronary revascularization procedures by 30 % ( $p < 0.0001$ ) and 16 % ( $p = 0.006$ ), respectively. Simvastatin reduced the risk of stroke by 25 % ( $p < 0.0001$ ), attributable to a 30 % reduction in ischemic stroke ( $p < 0.0001$ ). In addition, within the subgroup of patients with diabetes, simvastatin reduced the risk of developing macrovascular complications, including peripheral revascularization procedures (surgery or angioplasty), lower limb amputations, or leg ulcers by 21 % ( $p = 0.0293$ ). The proportional reduction in event rate was similar in each subgroup of patients studied, including those without coronary disease but who had cerebrovascular or peripheral artery disease, men and women, those aged either under or over 70 years at entry into the study, presence or absence of hypertension, and notably those with LDL cholesterol below 3.0 mmol/l at inclusion.

In the Scandinavian Simvastatin Survival Study (4S), the effect of therapy with simvastatin on total mortality was assessed in 4,444 patients with CHD and baseline total cholesterol 212-309 mg/dL (5.5-8.0 mmol/L). In this multicenter, randomised, double-blind, placebo-controlled study, patients with angina or a previous myocardial infarction (MI) were treated with diet, standard care, and either simvastatin 20-40 mg/day ( $n = 2,221$ ) or placebo ( $n = 2,223$ ) for a median duration of 5.4 years. Simvastatin reduced the risk of death by 30 % (absolute risk reduction of 3.3 %). The risk of CHD death was reduced by 42 % (absolute risk reduction of 3.5 %). Simvastatin also decreased the risk of having major coronary events (CHD death plus hospital-verified and silent nonfatal MI) by 34 %. Furthermore, simvastatin significantly reduced the risk of fatal plus nonfatal cerebrovascular events (stroke and transient ischemic attacks) by 28 %. There was no statistically significant difference between groups in non-cardiovascular mortality.

### Primary Hypercholesterolaemia and Combined Hyperlipidaemia

In studies comparing the efficacy and safety of simvastatin 10, 20, 40 and 80 mg daily in patients with hypercholesterolaemia, the mean reductions of LDL-C were 30,38,41 and 47 %, respectively. In studies of patients with combined (mixed) hyperlipidaemia on simvastatin 40 mg and 80 mg, the median reductions in triglycerides were 28 and 33 % (placebo: 2 %), respectively, and mean increases in HDL-C were 13 and 16 % (placebo: 3 %), respectively.

## **5.2 Pharmacokinetic properties**

Simvastatin is an inactive lactone which is readily hydrolyzed *in vivo* to the corresponding beta-hydroxyacid, a potent inhibitor of HMG-CoA reductase. Hydrolysis takes place mainly in the liver; the rate of hydrolysis in human plasma is very slow.

### *Absorption*

In man simvastatin is well absorbed and undergoes extensive hepatic first-pass extraction. The extraction in the liver is dependent on the hepatic blood flow. The liver is the primary site of action of the active form. The availability of the beta-hydroxyacid to the systemic circulation following an oral dose of simvastatin was found to be less than 5 % of the dose. Maximum plasma concentration of active inhibitors is reached approximately 1-2 hours after administration of simvastatin. Concomitant food intake does not affect the absorption.

The pharmacokinetics of single and multiple doses of simvastatin showed that no accumulation of medicinal product occurred after multiple dosing.

### *Distribution*

The protein binding of simvastatin and its active metabolite is > 95 %.

### *Elimination*

Simvastatin is a substrate of CYP3A4 (*see sections 4.3 and 4.5*). The major metabolites of simvastatin present in human plasma are the beta-hydroxyacid and four additional active metabolites. Following an oral dose of radioactive simvastatin to man, 13 % of the radioactivity was excreted in the urine and 60 % in the faeces within 96 hours. The amount recovered in the faeces represents absorbed medicinal product equivalents excreted in bile as well as unabsorbed medicinal product. Following an intravenous injection of the beta-hydroxyacid metabolite, its half-life averaged 1.9 hours. An average of only 0.3 % of the IV dose was excreted in urine as inhibitors.

## **5.3 Preclinical safety data**

Based on conventional animal studies regarding pharmacodynamics, repeated dose toxicity, genotoxicity and carcinogenicity, there are no other risks for the patient than may be expected on account of the pharmacological mechanism. At maximally tolerated doses in both the rat and the rabbit, simvastatin produced no foetal malformations, and had no effects on fertility, reproductive function or neonatal development.

## **6 PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

#### Tablet core:

lactose anhydrous  
microcrystalline cellulose  
pregelatinised maize starch  
butylhydroxyanisole  
magnesium stearate  
talc

#### Film-coating:

hydroxypropyl cellulose  
hypromellose  
titanium dioxide  
talc

### **6.2 Incompatibilities**

Not applicable.

### **6.3 Shelf Life**

3 years.

### **6.4 Special precautions for storage**

No special precautions for storage.

### **6.5 Nature and contents of container**

10, 14, 20, 28, 30, 50, 56, 60, 84, 98, 100 tablet, per blister card 10, 14 or 20 tablets (PVC/PE/PVDC/Al blister or PVC/PE/PVDC/Al blister in Al sachet).

49, 50, 56 or 100 tablets, per blister card 5, 7, 10 or 14 tablets (perforated unit dose blister for hospital use - PVC/PE/PVDC/Al blister)

100, 250 or 300 tablets packed in HDPE tablet containers with a child-resistant closure.

Not all package sizes may be marketed.

## **6.6 Special precautions for disposal of a used medicinal product or waste materials derived from such medicinal product and other handling of the product**

No special requirements.

## **7 MARKETING AUTHORISATION HOLDER**

CT-Arzneimittel GmbH  
Lengeder Strasse 42a  
13407 Berlin  
Germany

## **8 MARKETING AUTHORISATION NUMBER**

PA 1081/001/004

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

First date of authorisation: 11 October 2002

Last date of authorisation: 11 October 2007

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

December 2008