

SUMMARY OF PRODUCT CHARACTERISTICS

1 NAME OF THE MEDICINAL PRODUCT

Carvedilol 12.5mg Tablets

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each tablet contains 12.5 mg carvedilol.

Excipients with known effect:

Each tablet contains 55.5 mg of lactose (as lactose monohydrate).

For a full list of excipients, see section 6.1

3 PHARMACEUTICAL FORM

Tablet.

Red/brown, round, convex, scored tablet encoded C3 on one side with an approximate size of 7 mm.

The score line is only to facilitate breaking for ease of swallowing and not to divide into equal doses.

4.1 Therapeutic Indications

Treatment of hypertension

Long-term management of chronic stable angina pectoris

Adjunctive treatment in moderate to severe stable heart failure to reduce morbidity and increase patient well-being.

4.2 Posology and method of administration

Posology

Essential hypertension:

Carvedilol may be used for the treatment of hypertension alone or in combination with other antihypertensives, especially thiazide diuretics. Once daily dosing is recommended, however the recommended maximum daily dose is 50 mg.

Adults: The recommended initial dose is 12.5 mg once daily for two days. Thereafter, the treatment is continued at the dose 25 mg/day. If necessary, the dose may be further increased gradually to a recommended daily maximum dose of 50 mg given once a day or in divided doses at intervals of two weeks or more rarely.

Dose titration should occur at intervals of at least two weeks.

Elderly: The recommended initial dose in hypertension is 12.5 mg once daily, which may also be sufficient for continued treatment. However, if the therapeutic response is inadequate at this dose, the dose may be further increased gradually up to the recommended daily maximum dose of 50 mg given once a day or in divided doses at intervals of two weeks or more rarely.

Paediatric population:

Safety and efficacy in children (under 18 years) has not been established.

Angina

Adults

The recommended dose for initiation of therapy is 12.5 mg twice a day for the first two days. Thereafter, the recommended dosage is 25 mg twice a day. If necessary, the dose may be titrated up to 50 mg twice a day.

Dose titration should occur at intervals of at least two weeks.

Elderly

The recommended maximum daily dose is 50 mg given in divided doses.

Special dosage instructions

As with all beta-blockers, treatment should not be stopped abruptly but rather gradually reduced at weekly intervals. This is particularly important in the case of patients with concomitant coronary heart disease.

Renal impairment

Pharmacokinetic data and clinical studies in patients with renal impairment (including renal failure) suggest no dose adjustment is needed in moderate to severe renal impairment (see section 4.4 and 5.2).

Paediatric population:

Safety and efficacy in children (under 18 years) has not been established (see section 5.1).

Symptomatic congestive heart failure:

The dosage must be titrated to individual requirements and monitored during up-titration. For Congestive Heart Failure (CHF) patients carvedilol should be given with food to slow the rate of absorption and reduce the incidence of orthostatic effects.

For those patients receiving diuretics and/or digoxin and/or ACE inhibitors, dosing of these other drugs should be stabilised prior to initiation of Carvedilol Tablets treatment.

Adults

The initial dose is 3.125 mg twice daily for two weeks. If the initial dose is well tolerated, the carvedilol dose can be increased at intervals of two weeks or more rarely, first to 6.25 mg twice daily, then 12.5 mg twice daily followed by 25 mg twice daily. It is recommended that the dose is increased to the highest level tolerated by the patient.

The recommended maximum dose is 25 mg given twice daily in patients weighing less than 85 kg and 50 mg twice daily in patients weighing more than 85 kg. In patients with mild or moderate CHF weighing more than 85 kg, the maximum recommended dose is 50 mg twice daily.

Before each dose increase the patient should be evaluated by the physician for symptoms of worsening heart failure or vasodilation. Transient worsening of heart failure, vasodilation or fluid retention may be treated with increased doses of diuretics or ACE inhibitors or by modifying or temporarily discontinuing Carvedilol Tablets treatment. Under these circumstances, the dose of Carvedilol Tablets should not be increased until symptoms of worsening heart failure or vasodilation have been stabilised.

If carvedilol treatment is discontinued for more than one week, therapy should be recommenced at a lower dose level (twice daily) and up-titrated in line with the above dosing recommendation.

If Carvedilol Tablets therapy is discontinued for more than two weeks, it should be reinitiated at 3.125 mg twice daily and increased gradually in accordance with the above recommendation.

Elderly: As for adults elderly patients may be more susceptible to the effects of carvedilol and should be monitored more carefully.

Paediatric population

Children and adolescents (< 18 years): There is insufficient data of the efficacy and safety of carvedilol. (See section 5.1)

Methods of administration

The tablets do not need to be taken with a meal. However, it is recommended that heart failure patients take their carvedilol medication with food to allow the absorption to be slower and the risk of orthostatic hypotension to be reduced.

Carvedilol tablets are for oral use only.

The tablets should be taken with fluid.

4.3 Contraindications

- Hypersensitivity to active substance or to any of the excipients listed in section 6.1.
- Unstable/decompensated heart failure requiring intravenous inotropic support.
- Clinically manifest liver dysfunction.
- As with other beta-blocking agents:
 - History of bronchospasm or asthma.
 - Second or third degree atrioventricular (AV) block (unless a permanent pacemaker is in place).
 - Severe bradycardia (< 50 bpm).
 - Cardiogenic shock.
 - Sick sinus syndrome (including sinoatrial blocks).
 - Severe hypotension (systolic blood pressure below 85 mmHg).

4.4 Special warnings and precautions for use

Chronic Congestive Heart Failure

In congestive heart failure patients, worsening cardiac failure or fluid retention may occur during up-titration of Carvedilol Tablets. If such symptoms occur, diuretics should be increased and the Carvedilol Tablets dose should not be advanced until clinical stability resumes. Occasionally, it may be necessary to lower the Carvedilol Tablets dose or, in rare cases, temporarily discontinue it. Such episodes do not preclude subsequent successful up-titration of Carvedilol Tablets. Carvedilol should be used with caution in combination with digitalis glycosides, since both medicinal products slow AV conduction (see section 4.5).

Renal function in Congestive Heart Failure

Reversible deterioration of renal function has been observed during Carvedilol Tablets therapy in chronic heart failure patients with low blood pressure (systolic < 100 mm Hg), ischaemic heart disease and diffuse vascular disease and/or underlying renal insufficiency.

In CHF patients with these risk factors, renal function should be monitored during dose titration of Carvedilol Tablets. If significant worsening of renal

function occurs, the carvedilol dose must be reduced or therapy must be discontinued.

Chronic obstructive pulmonary disease

Carvedilol should be used with caution, in patients with chronic obstructive pulmonary disease (COPD) with a bronchospastic component who are not receiving oral or inhaled medication, and only if the potential benefit outweighs the potential risk. In patients with a tendency to bronchospasm, respiratory distress can occur as a result of a possible increase in airway resistance. Patients should be closely monitored during initiation and up-titration of carvedilol and the dose of Carvedilol Tablets should be reduced if any evidence of bronchospasm is observed during treatment.

Diabetes

Care should be taken in the administration of Carvedilol Tablets to patients with diabetes mellitus, as it may be associated with worsening control of blood glucose, or the early signs and symptoms of acute hypoglycaemia may be masked or attenuated.

Alternatives to beta-blocking agents are generally preferred in insulin-dependent patients. Therefore, regular monitoring of blood glucose is required in diabetics when Carvedilol Tablets is initiated or up-titrated and hypoglycaemic therapy adjusted accordingly (see section 4.5).

Peripheral vascular disease and Raynaud's phenomenon:

Carvedilol Tablets should be used with caution in patients with peripheral vascular disease (e.g. Raynaud's phenomenon) as beta-blockers can precipitate or aggravate symptoms of arterial insufficiency.

Thyrotoxicosis

Carvedilol Tablets may mask symptoms and signs of thyrotoxicosis.

Bradycardia

Carvedilol Tablets may induce bradycardia. If the patient's pulse rate decrease in pulse rate to less than 55 beats per minute, the dosage of Carvedilol Tablets should be reduced.

Hypersensitivity

Care should be taken in administering Carvedilol Tablets to patients with a history of serious hypersensitivity reactions and in those undergoing desensitisation therapy as beta-blockers may increase both the sensitivity towards allergens and the severity of hypersensitivity reactions.

Risk of Anaphylactic Reaction: While taking beta-blockers, patients with a history of severe anaphylactic reaction to a variety of allergens may be more reactive to repeated challenge, either accidental, diagnostic, or therapeutic. Such patients may be unresponsive to the usual doses of epinephrine used to treat allergic reaction.

Severe cutaneous adverse reactions (SCARs)

Very rare cases of severe cutaneous adverse reactions such as toxic epidermal necrolysis (TEN) and Stevens-Johnson syndrome (SJS) have been reported during treatment with Carvedilol Tablets (see section 4.8).

Carvedilol Tablets should be permanently discontinued in patients who experience severe cutaneous adverse reactions possibly attributable to Carvedilol Tablets.

Psoriasis

Cautions should be exercised when prescribing beta-blockers to patients with history of psoriasis associated with β -blocker therapy since skin reactions may be aggravated and should take Carvedilol Tablets only after consideration of the risk-benefit ratio.

Interactions with other medicinal products: There are a number of important pharmacokinetic and pharmacodynamic interactions with other drugs (e.g., digoxin, ciclosporin, rifampicin, anaesthetic drugs, and antiarrhythmic drug. See section 4.5).

Phaeochromocytoma

In patients with pheochromocytoma, an alpha-blocking agent should be initiated prior to the use of any beta-blocking agent. Although Carvedilol Tablets has both alpha- and beta-blocking pharmacological activities, there is no experience with its use in this condition. Caution should therefore be taken in the administration of Carvedilol Tablets to patients suspected of having phaeochromocytoma.

Prinzmetal's variant angina

Agents with non-selective beta-blocking activity may provoke chest pain in patients with Prinzmetal's variant angina. There is no clinical experience with carvedilol in these patients although the alpha-blocking activity of carvedilol may prevent such symptoms. Caution should, however, be taken in the administration of carvedilol to patients suspected of having Prinzmetal's variant angina.

Contact lenses

Wearers of contact lenses should be advised of the possibility of reduced lacrimation.

Withdrawal syndrome

Although angina has not been reported on stopping treatment, carvedilol therapy must be discontinued gradually within two weeks, particularly in patients with ischaemic heart disease, as Carvedilol Tablets has beta-blocking activity.

Lactose

This medicinal product contains lactose. Patients with rare hereditary problems of galactose intolerance, total lactase deficiency or glucose-galactose malabsorption should not take this medicine.

4.5 Interactions with other medicinal products and other forms of interaction

Pharmacokinetic interactions

Effects of Carvedilol Tablets on the pharmacokinetics of other medicinal products

Carvedilol is a substrate as well as an inhibitor of P-glycoprotein. Therefore the bioavailability of drugs transported by P-glycoprotein may be increased with concomitant administration of carvedilol. In addition, the bioavailability of carvedilol can be modified by inducers or inhibitors of P-glycoprotein.

Digoxin: An increased exposure of digoxin of up to 20% has been shown in some studies in healthy subjects and patients with heart failure. A significantly larger effect has been seen in male patients compared to female patients. Therefore monitoring of digoxin levels is recommended when initiating, adjusting or discontinuing carvedilol (see section 4.4). Carvedilol had no effect on digoxin administered intravenously.

Ciclosporin and tacrolimus: Two studies in renal and cardiac transplant patients receiving oral ciclosporin have shown an increase in ciclosporin plasma concentration following the initiation of carvedilol. It appears that carvedilol increases exposure to oral ciclosporin by around 10 to 20%. In an attempt to maintain therapeutic ciclosporin levels, an average 10-20% reduction of the ciclosporin dose was necessary. The mechanism for the interaction is not known but inhibition of intestinal P glycoprotein by carvedilol may be involved. Due to wide interindividual variability of ciclosporin levels, it is recommended that ciclosporin concentrations are monitored closely after initiation of carvedilol therapy and that the dose of ciclosporin be adjusted as appropriate.

In case of IV administration of ciclosporin, no interaction with carvedilol is expected.

Furthermore, there is evidence that CYP3A4 is involved in the metabolism of carvedilol. As tacrolimus is a substrate of P-glycoprotein and CYP3A4, its pharmacokinetics may also be affected by carvedilol through these interaction mechanisms.

Effects of other medicinal products on the pharmacokinetics of Carvedilol

Inhibitors as well as inducers of CYP2D6 and CYP2C9 can modify the systemic and/or presystemic metabolism of carvedilol stereoselectively, leading to increased or decreased plasma concentrations of R and S-carvedilol. Some examples observed in patients or in healthy subjects are listed below but the list is not exhaustive.

Rifampicin: In a study in 12 healthy subjects, exposure to carvedilol decreased by around 60% during concomitant administration with rifampicin and a decreased effect of carvedilol on the systolic blood pressure was observed. The mechanism for the interaction is not known but it may be due to the induction of the intestinal P glycoprotein by rifampicin. A close monitoring of the β -blockade activity in patients receiving concomitant administration of carvedilol and rifampicin is appropriate.

Amiodarone: An in vitro study with human liver microsomes has shown that amiodarone and desethylamiodarone inhibited the oxidation of R and S-carvedilol. The trough concentration of R and S-carvedilol was significantly increased by 2.2-fold in heart failure patients receiving carvedilol and amiodarone concomitantly as compared to patients receiving carvedilol monotherapy.

The effect on S-carvedilol was attributed to desethylamiodarone, a metabolite of amiodarone, which is a strong inhibitor of CYP2C9. A monitoring of the β -blockade activity in patients treated with the combination carvedilol and amiodarone is advised.

Fluoxetine and Paroxetine: In a randomized, cross-over study in 10 patients with heart failure, coadministration of fluoxetine, a strong inhibitor of CYP2D6, resulted in stereoselective inhibition of carvedilol metabolism with a 77% increase in mean R(+) enantiomer's AUC, and a non-statistically 35% increase of the S(-) enantiomer's AUC as compared to the placebo group. However, no differences in adverse events, blood pressure or heart rate were noted between treatment groups. The effect of single dose paroxetine, a strong CYP2D6 inhibitor, on carvedilol pharmacokinetics was investigated in 12 healthy subjects following single oral administration. Despite significant increase in R and S-carvedilol exposure, no clinical effects were observed in these healthy subjects.

Alcohol: Alcohol intake is shown to have acute hypotensive effects which may augment the blood pressure reduction caused by carvedilol. As carvedilol is soluble in ethanol, the presence of alcohol could affect the rate and/or extent of intestinal absorption of carvedilol. Also, carvedilol is partly metabolized by CYP2E1, an enzyme known to be induced and inhibited by alcohol.

Grapefruit juice: Consumption of a single dose of 300 ml grapefruit juice results in a 1.2-fold increase of the AUC of carvedilol in comparison to water. While clinical relevance is unclear, patients should avoid concomitant intake of grapefruit juice, at least until a stable dose-response relationship is established.

Pharmacodynamic interactions

Insulin or oral hypoglycaemics: Agents with beta-blocking properties may enhance the blood-sugar-reducing effect of insulin and oral hypoglycaemics. The signs of hypoglycaemia may be masked or attenuated (especially tachycardia). In patients taking insulin or oral hypoglycaemics, regular monitoring of blood glucose is therefore recommended (see section 4.4).

Catecholamine-depleting agents: Patients taking both agents with β -blocking properties and a medicinal product that can deplete catecholamines (eg reserpine and monoamine oxidase inhibitors) should be observed closely for signs of hypotension and/or severe bradycardia.

Digoxin: The combined use of beta-blockers and digoxin may result in additive prolongation of atrioventricular (AV) conduction time.

Non-dihydropyridines calcium channel blockers or other antiarrhythmics: The combined use of non-dihydropyridine calcium channel blockers, amiodarone or other antiarrhythmics with carvedilol can increase the risk of AV conduction disturbances (see section 4.4). Isolated cases of conduction disturbance (rarely with haemodynamic compromise) have been observed when carvedilol is co-administered with diltiazem. As with other agents with β -blocking properties, if carvedilol is to be administered orally with non-dihydropyridines calcium channel blockers of the verapamil or diltiazem type, amiodarone or other antiarrhythmics it is recommended that ECG and blood pressure be monitored.

Clonidine: Concomitant administration of clonidine with agents with β -blocking properties may potentiate blood-pressure- and heart-rate-lowering effects. When combination treatment with agents with beta-blocking properties and clonidine is to be terminated, the beta-blocking agent should be discontinued first. Clonidine therapy can then be discontinued several days later by gradually decreasing the dosage.

Antihypertensives: As with other agents with beta-blocking activity, Carvedilol Tablets may potentiate the effect of other concomitantly administered medicinal products that are anti-hypertensive in action (e.g. alpha-1-receptor antagonists) or have hypotension as part of their adverse effect profile.

Anaesthetic agents: Careful attention must be paid during general anaesthesia to the synergistic negative inotropic and hypertensive effects of carvedilol and anaesthetic drugs (see section 4.4).

NSAIDs: The concurrent use of nonsteroidal anti-inflammatory drugs (NSAIDs) and beta-adrenergic blockers may result in an increase in blood pressure and impairment of blood pressure control.

Beta-agonist bronchodilators: Non-cardioselective beta blockers oppose the bronchodilator effects of beta-agonist bronchodilators. Careful monitoring of patients is recommended.

4.6 Fertility, pregnancy and lactation

Pregnancy

There is no adequate clinical experience with carvedilol in pregnant women.

Animal studies demonstrated effects on pregnancy, embryonal/foetal development, parturition and postnatal development (see section 5.3). The potential risk for humans is unknown.

Carvedilol should not be used during pregnancy unless the potential benefit outweighs the potential risk.

Beta-blockers reduce placental perfusion which may result in intrauterine foetal death and immature and premature deliveries. In addition, adverse effects (especially hypoglycaemia bradycardia) may occur in the foetal and neonate). There may be an increased risk of cardiac and pulmonary complications in the neonate in the postnatal period. Animal studies have not shown substantive evidence of teratogenicity with carvedilol (see also section 5.3).

Breast-feeding

Animal studies demonstrated that carvedilol and/or its metabolites are excreted in rat breast milk. The excretion of carvedilol in human milk has not been established. However, most β -blockers, in particular lipophilic compounds, will pass into human breast milk although to a variable extent. Breast feeding is therefore not recommended following administration of carvedilol.

4.7 Effects on ability to drive and use machines

No studies have been performed on the effects of carvedilol on patients' fitness to drive or to operate machinery.

As for other medicinal products which produce changes in blood pressure, patients taking carvedilol should be warned not to drive or operate machinery if they experience dizziness or related symptoms. This applies particularly when starting or changing treatment and in conjunction with alcohol.

4.8 Undesirable effects

(a) Summary of the safety profile

The frequency of adverse reactions is not dose-dependent except for dizziness, visual disturbances and bradycardia.

(b) Table of adverse reactions

The risk of most adverse reactions associated with carvedilol is similar for all indications. The exceptions are described in subsection (c).

The following undesirable effects have been reported to occur when carvedilol is administered:

Frequency categories are as follows:

Very common $\geq 1/10$

Common $\geq 1/100$ and $< 1/10$

Uncommon $\geq 1/1,000$ and $< 1/100$

Rare $\geq 1/10,000$ and $< 1/1,000$

Very rare $< 1/10,000$

Not known (cannot be estimated from the available data)

Table 1: Adverse Reactions

System organ class	Frequency	Adverse reaction
Infections and infestations	Common	Pneumonia
		Bronchitis
		Upper respiratory tract infection
		Urinary tract infection
Blood and lymphatic system disorders	Common	Anaemia
	Rare	Thrombocytopenia
	Very rare	Leukopenia
Immune system disorders	Very rare	Hypersensitivity (allergic reactions)
Metabolism and nutrition disorders	Common	Weight increase
		Hypercholesterolemia
		Impaired blood glucose control (hyperglycaemia, hypoglycaemia) in patients with pre-existing diabetes
Psychiatric disorders	Common	Depression, depressed mood
	Uncommon	Sleep disorders
Nervous system	Very common	Dizziness

System organ class	Frequency	Adverse reaction
disorders		Headache
	Common	Syncope, presyncope
	Uncommon	Paraesthesia
Eye disorders	Common	Visual impairment
		Lacrimation decreased (dry eye)
		Eye irritation
Cardiac disorders	Very common	Cardiac failure
	Common	Bradycardia
		Hypervolemia (Fluid overload)
	Uncommon	Atrioventricular block
		Angina pectoris
Vascular disorders	Very common	Hypotension
	Common	Orthostatic hypotension,
		Disturbances of peripheral circulation (cold extremities, peripheral vascular disease, exacerbation of intermittent claudication and reynaud's phenomenon)
		Hypertension
Respiratory, thoracic and mediastinal disorders	Common	Dyspnoea
		Pulmonary oedema
		Asthma in predisposed patients
	Rare	Nasal congestion, flu-like symptoms
Gastrointestinal disorders	Common	Nausea
		Diarrhoea
		Vomiting
		Dyspepsia
		Abdominal pain
	Uncommon	Constipation
Rare	Dry mouth	
Hepatobiliary disorders	Very rare	Alanine aminotransferase (ALT), aspartate Aminotransferase (AST) and Gamma-glutamyltransferase (GGT) increased

System organ class	Frequency	Adverse reaction
Skin and subcutaneous disorders	Uncommon	Skin reactions (e.g. Allergic exanthema, dermatitis, urticaria, pruritus, psoriatic and lichen planus like skin lesions), alopecia
Musculoskeletal and connective tissue disorders	Common	Pain in extremities
Renal and urinary disorders	Common	Renal failure and renal function abnormalities in patients with diffuse vascular disease and/or underlying renal insufficiency
	Rare	Micturition disorders
	Very rare	Urinary incontinence in women
Reproductive system and breast disorders	Uncommon	Erectile dysfunction
General disorders and administration site conditions	Very common	Asthenia (fatigue)
	Common	Oedema
		Pain

Description of selected adverse reactions

The frequency of adverse reactions is not dose-dependent, with the exception of dizziness, abnormal vision and bradycardia. Dizziness, syncope, headache and asthenia are usually mild and are more likely to occur at the beginning of treatment.

In patients with congestive heart failure, worsening cardiac failure and fluid retention may occur during up-titration of carvedilol dose (see section 4.4).

Cardiac failure is a commonly reported adverse event in both placebo and carvedilol-treated patients (14.5% and 15.4% respectively, in patients with left ventricular dysfunction following acute myocardial infarction).

Reversible deterioration of renal function has been observed with carvedilol therapy in chronic heart failure patients with low blood pressure, ischaemic heart disease and diffuse vascular disease and/or underlying renal insufficiency (see section 4.4).

The following adverse events have been identified during post-marketing use of carvedilol. Because these events are reported from a population of uncertain size, it is not always possible to reliably estimate their frequency and/or establish a causal relationship to medicinal product exposure:

Metabolism and nutrition disorders

As a class, beta-adrenergic receptor blockers may cause latent diabetes to become manifest, manifest diabetes to be aggravated, and blood glucose counter-regulation to be inhibited.

Psychiatric disorders

Carvedilol may cause hallucinations.

Cardiac disorders

Sinus arrest may occur in predisposed patients (e.g. elderly patients or patients with pre-existing bradycardia, sinus node dysfunction or atrioventricular block).

Skin and subcutaneous tissue disorders

Severe cutaneous adverse reactions (Toxic epidermal necrolysis, Stevens-Johnson syndrome (see section 4.4).

Hyperhidrosis.

Renal and urinary disorders

Carvedilol may cause urinary incontinence in women which resolves upon discontinuation of the medication.

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the Yellow Card Scheme at www.mhra.gov.uk/yellowcard or search for MHRA Yellow Card in the Google Play or Apple App Store.

4.9 Overdose

Symptoms and signs:

In the event of overdose, there may be severe hypotension, bradycardia, heart failure, cardiogenic shock and cardiac arrest.

There may also be respiratory problems, bronchospasm, vomiting, disturbed consciousness and generalised seizures.

Treatment:

The patients should be monitored for the above mentioned signs and symptoms and managed according to the best judgment of the treating physicians and according to standard practice for patients with β -blocker overdose (e.g. atropine, transvenous pacing, glucagon, phosphodiesterase inhibitor such as amrinone or milrinone, β -sympathomimetics).

Gastric lavage or induced emesis may be useful in the first few hours after ingestion.

In cases of severe overdose with symptoms of shock, supportive treatment as described should be continued for a sufficiently long period of time, i.e. until the patient stabilises, since prolonged elimination half-life and redistribution of carvedilol from deeper compartments can be expected.

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: alpha- and beta-blocking agents
ATC code: C07AG02

Mechanism of action

Carvedilol is a racemic mixture of two enantiomers (R- and S-carvedilol), is a multiple action alpha- and beta-adrenergic receptor blocker. The beta-adrenergic receptor blockade is associated with the S-enantiomer and non-selective non-selective for beta₁ and beta₂ adrenoceptors, while both enantiomers have the same blocking properties specific for alpha 1-adrenergic receptors. At higher concentrations, carvedilol also has a weak to moderate calcium-channel blocking activity. It has no intrinsic sympathomimetic activity and (like propranolol) it has membrane-stabilising properties.

Pharmacodynamic effects

Carvedilol reduces peripheral vascular resistance by selective blockade of alpha₁-adrenoreceptors. Through its beta-blocking action, carvedilol suppresses the renin-angiotensin-aldosterone system reducing the release of renin and making fluid retention rare.

It attenuates the increase in blood pressure induced by phenylephrine, an alpha₁-adrenoceptor agonist, but not that induced by angiotensin II. Carvedilol's calcium-channel blocking activity may increase blood flow in specific vascular beds such as the cutaneous circulation.

Carvedilol has organ-protective effects, likely resulting at least in part from additional properties beyond its adrenergic receptor blockade action. It has potent antioxidant properties associated with both enantiomers, is a scavenger of reactive oxygen radicals and has antiproliferative effects on human vascular smooth muscle cells.

Carvedilol has no adverse effect on the lipid profile.

Clinical efficacy and safety

Clinical studies have shown that the balance of vasodilation and beta-blockade provided by carvedilol results in the following effects:

- In hypertensive patients, a reduction in blood pressure by beta-blockade and alpha₁-mediated vasodilation without a concomitant increase in total peripheral resistance, as observed with pure beta-blocking agents. Heart rate is slightly decreased. Renal blood flow and renal function are

maintained. Carvedilol has been shown to maintain stroke volume and reduce total peripheral resistance, without compromising blood supply to distinct organs and vascular beds e.g. kidneys, skeletal muscles, forearms, legs, skin, brain or the carotid artery. There is a reduced incidence of cold extremities and early fatigue during physical activity.

Hypertensive patients with renal renal impairment

Several open studies have shown that carvedilol is an effective agent in patients with renal hypertension. The same is true in patients with chronic renal failure, on haemodialysis or after renal transplantation.

Carvedilol causes a gradual reduction in blood pressure both on dialysis and non-dialysis days, and the blood pressure-lowering effects are comparable with those seen in patients with normal renal function.

Stable Angina pectoris

In patients with stable angina, Carvedilol Tablets has demonstrated anti-ischaemic (improved total exercise time, time to 1 mm ST segment depression and time to angina) and anti-anginal properties that were maintained during long-term treatment. Acute haemodynamic studies demonstrated that Carvedilol Tablets reduces both cardiac pre-load (pulmonary artery pressure and pulmonary capillary wedge pressure) and after-load (total peripheral resistance) with consequent improvement in left ventricular systolic and diastolic function without substantial changes in the cardiac output.

Carvedilol Tablets has no adverse effects on the metabolic risk factors of coronary heart disease. It does not impair the normal serum lipid profile and in hypertensive patients with dyslipidaemia favourable effects on the serum lipids have been reported after six months of oral therapy.

In two studies, Carvedilol Tablets 25 mg b.i.d. was compared with other anti-anginal drugs of recognised value in patients with chronic stable exertional angina. The dose regimens that were chosen were those widely used in clinical practice. Both trials had a double-blind, parallel group design. The primary objective was total exercise time (TET).

Report no:	Control (dose)	Patient numbers carvedilol/comparator drug	Duration of treatment
060	Verapamil (120mg t.i.d.)	126/122	12 weeks
061	ISDN s.r. (40mg b.i.d.)	93/94	12 weeks

The results of both trials clearly demonstrated that for TET at trough blood drug levels after 12 weeks of therapy there was no statistically significant difference between treatment groups. However the risk ratios obtained from the Cox proportional hazards model showed a trend in favour of carvedilol

indicating that on average carvedilol was 114% as effective as verapamil (90% CI: 85-152%) and 134% as effective as ISDN (90% CI: 96-185%). This was also true for time to angina (TTA) and ST-segment depression (TST) at trough. The increase in TET was about 50 seconds in all groups; the improvements for TTA and TST were about 30 seconds, which is clinically relevant.

In study 060, 48h Holter monitoring data measurements demonstrated a reduction of number and duration of ST-segment depressions (silent myocardial ischaemia) in both treatment groups. Carvedilol also decreased premature atrial and ventricular contractions (PAC, PVC), couplets and runs.

Chronic Heart Failure

Carvedilol significantly reduces mortality and hospitalisations and improves symptoms and left ventricular function in patients with ischaemic or non-ischaemic chronic heart failure. The effect of carvedilol is dose dependent.

Chronic Heart Failure patients with renal impairment

Carvedilol reduces morbidity and mortality in dialysis patients with dilated cardiomyopathy. A meta-analysis of placebo-controlled clinical trials including a large number of patients (>4000) with mild to moderate chronic kidney disease supports carvedilol treatment of patients with left ventricular dysfunction with or without symptomatic heart failure to reduce rates of all cause of mortality as well as heart failure related events.

Paediatric population

The safety and efficacy of carvedilol in children and adolescents has not been established due to limited number and size of studies. Available studies focus on treatment of paediatric heart failure which differs from the disease in adults regarding characteristics and aetiology. Because of the small number of participants compared to studies in adults and a general lack of an optimal dosing scheme for children and adolescents, available data is not sufficient to establish a paediatric safety profile for carvedilol.

5.2 Pharmacokinetic properties

Absorption

Following oral administration of a 25 mg capsule to healthy subjects, carvedilol is rapidly absorbed with a peak plasma concentration C_{max} of 21 µg/L reached after approximately 1.5 hour (t_{max}). The C_{max} values are linearly related to the dose.

Following oral administration, carvedilol undergoes extensive first pass metabolism that results in an absolute bioavailability of about 25% in healthy male subjects. Carvedilol is a racemate and the S-(-)- enantiomer appears to be metabolized more rapidly than the R-(+)- enantiomer, showing an absolute oral bioavailability of 15% compared to 31% for the R-(+)- enantiomer . The maximal plasma concentration of R-carvedilol is approximately 2 fold higher than that of S-carvedilol.

In vitro studies have shown that carvedilol is a substrate of the efflux transporter P-glycoprotein. The role of P-glycoprotein in the disposition of carvedilol was also confirmed in vivo in healthy subjects. Food does not affect bioavailability, residence time or the maximum serum concentration, although the time to reach maximum serum concentration is delayed.

Distribution

Carvedilol is highly lipophilic, showing a plasma protein of around 95%. The distribution volume ranges between 1.5 and 2 L/kg and increased in patients with liver cirrhosis.

Biotransformation

In humans, carvedilol is extensively metabolized in the liver via oxidation and conjugation into a variety of metabolites that are eliminated mainly in the bile. Enterohepatic circulation of the parent substance has been shown in animals. Demethylation and hydroxylation at the phenol ring produce three metabolites with beta-adrenergic receptor blocking activity.

Based on pre-clinical studies, the 4'-hydroxy-phenol metabolite is approximately 13 times more potent than carvedilol for beta-blockade. Compared to carvedilol, the three active metabolites exhibit weak vasodilating activity. In humans, the concentrations of the three active metabolites are about 10 times lower than that of the parent substance. Two of the hydroxy-carbazole metabolites of carvedilol are extremely potent antioxidants, demonstrating a 30 to 80-fold greater potency than carvedilol.

Pharmacokinetic studies in human have shown that the oxidative metabolism of carvedilol is stereo selective. The results of an in vitro study suggested that different cytochrome P450 isoenzymes may be involved in the oxidation and hydroxylation processes including CYP2D6, CYP3A4, CYP2E1, CYP2C9, as well as CYP1A2.

Studies in healthy volunteers and in patients have shown that the R-enantiomer is predominantly metabolized by CYP2D6. The S-enantiomer is mainly metabolized by CYP2D6 and CYP2C9.

Genetic polymorphism

The results of clinical pharmacokinetic studies in human subjects have shown that CYP2D6 plays a major role in the metabolism of R and of S-carvedilol.

As a consequence plasma concentrations of R and S-carvedilol are increased in CYP2D6 slow metabolisers.

The importance of CYP2D6 genotype in the pharmacokinetics of R and S-carvedilol was confirmed in population pharmacokinetics studies, whereas other studies did not confirm this observation. It was concluded that CYP2D6 genetic polymorphism may be of limited clinical significance.

Elimination

Following a single oral administration of 50 mg carvedilol, around 60% are secreted into the bile and eliminated with the faeces in the form of metabolites within 11 days. Following a single oral dose, only about 16% are excreted into the urine in form of carvedilol or its metabolites. The urinary excretion of unaltered drug represents less than 2%. After intravenous infusion of 12.5 mg to healthy volunteers, the plasma clearance of carvedilol reaches around 600 mL/min and the elimination half-life around 2.5 hours. The elimination half-life of a 50 mg capsule observed in the same individuals was 6.5 hours corresponding indeed to the absorption half-life from the capsule. Following oral administration, the total body clearance of the S-carvedilol is approximately two times larger than that of the R-carvedilol.

Special populations

Elderly: Age has no statistically significant effect on the pharmacokinetics of carvedilol in hypertensive patients.

Paediatric population: Investigation in paediatrics has shown that the weight-adjusted clearance is significantly larger in paediatrics as compared to adults.

Hepatic impairment: In a study in patients with cirrhotic liver disease, the bioavailability of carvedilol was four times greater and the peak plasma level five times higher than in healthy subjects.

Renal impairment: Since carvedilol is primarily excreted via the faeces, significant accumulation in patients with renal impairment is unlikely.

In patients with hypertension and renal insufficiency, the area under plasma level-time curve, elimination half-life and maximum plasma concentration does not change significantly. Renal excretion of the unchanged drug decreases in the patients with renal insufficiency; however changes in pharmacokinetic parameters are modest.

Carvedilol is not eliminated during dialysis because it does not cross the dialysis membrane, probably due to its high plasma protein binding.

Heart failure: In a study in 24 Japanese patients with heart failure, the clearance of R- and S-carvedilol was significantly lower than previously estimated in healthy volunteers. These results suggested that the

pharmacokinetics of R- and S-carvedilol is significantly altered by heart failure in Japanese patients.

5.3 Preclinical safety data

Non-clinical data reveal no special hazard for humans based on conventional studies of safety pharmacology, repeated dose toxicity, genotoxicity, and carcinogenic potential.

Impairment of fertility

Administration of carvedilol to adult female rats at toxic doses (≥ 200 mg/kg, ≥ 100 times MRHD) resulted in impairment of fertility (poor mating, fewer corpora lutea and fewer implants).

Teratogenicity

There is no evidence from animal studies that carvedilol has any teratogenic effects.

Embryotoxicity

Embryotoxicity was observed only after large doses in rabbits. Doses > 60 mg/kg (> 30 times MRHD) caused delays in physical growth/development of offspring. There was embryotoxicity (increased post-implantation deaths) but no malformations in rats and rabbits at doses of 200 mg/kg and 75 mg/kg, respectively (38 to 100 times MRHD). The relevance of these findings for humans is uncertain. In addition, animal studies have shown that carvedilol crosses the placental barrier and therefore the possible consequences of alpha and beta blockade in the human foetus and neonate should also be borne in mind (although see section 4.6).

In summary, effects in non-clinical studies were observed only at exposures considered sufficiently in excess of the maximum human exposure indicating little relevance to clinical use (see section 4.6)

6 PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Lactose monohydrate.
Cellulose, microcrystalline.
Crospovidone.
Povidone K30.
Silica, colloidal anhydrous.
Magnesium stearate.
Colouring agents:
Ferric oxide, red (E172)
Ferric oxide, yellow (E172)

6.2 Incompatibilities

Not applicable

6.3 Shelf life

4 years

6.4 Special precautions for storage

Polyethylene (PE-HD) containers and closures: Store in the original container.
Blister (Al/PVC): Store in the original package.

6.5 Nature and contents of container

Polyethylene (PE/HD) containers and closures: 28, 30, 60, 100, 250 and 500 tablets.

Blister (Al/PVC): 14, 20, 28, 30, 50, 50x1, 56, 60, 98, 98x1 and 100 tablets.

Not all pack size and pack types may be marketed.

6.6 Special precautions for disposal

No special requirements for disposal.

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

7 MARKETING AUTHORISATION HOLDER

Crescent Pharma Ltd.,
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Sarum Hill, Basingstoke,
RG21 8SR, UK.

8 MARKETING AUTHORISATION NUMBER(S)

PL 20416/0594

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

16/12/2024

10 DATE OF REVISION OF THE TEXT

05/06/2025