

## **1. NAME OF THE MEDICINAL PRODUCT**

Abrad 5 mg film-coated tablets

Abrad 7.5 mg film-coated tablets

## **2. QUALITATIVE AND QUANTITATIVE COMPOSITION**

### Ivabradine 5 mg film-coated tablets

Each film-coated tablet contains 5 mg Ivabradine (as hydrochloride).

Excipient with known effect:

Each film-coated tablet contains 50 mg lactose monohydrate.

### Ivabradine 7.5 mg film-coated tablets

Each film-coated tablet contains 7.5 mg Ivabradine (as hydrochloride).

Excipient with known effect:

Each film-coated tablet contains 75 mg lactose monohydrate.

For the full list of excipients, see section 6.1.

## **3. PHARMACEUTICAL FORM**

Film-coated tablet.

### Ivabradine 5 mg film-coated tablets

White colored, oval shape, biconvex, film coated tablet scored and engraved with '5' at one side, plain on the other.

The tablet can be divided into equal doses.

### Ivabradine 7.5 mg film-coated tablets

White colored, round, biconvex, film coated tablet, engraved with '7.5' at one side, plain on the other.

## **4. CLINICAL PARTICULARS**

### **4.1 Therapeutic indications**

#### Symptomatic treatment of chronic stable angina pectoris

Ivabradine is indicated for the symptomatic treatment of chronic stable angina pectoris in coronary artery disease patients with normal sinus rhythm and heart rate  $\geq 70$ bpm. Ivabradine is indicated:

- in adults unable to tolerate or with a contra-indication to the use of beta-blockers
- or in combination with beta-blockers in patients inadequately controlled with an optimal beta blocker dose.

#### Treatment of chronic heart failure

Ivabradine is indicated in chronic heart failure NYHA II to IV class with systolic dysfunction, in patients in sinus rhythm and whose heart rate is  $\geq 75$  bpm, in combination with standard therapy including betablocker therapy or when beta-blocker therapy is contraindicated or not tolerated. (see section 5.1)

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

#### Posology

### *Symptomatic treatment of chronic stable angina pectoris*

It is recommended that the decision to initiate or titrate treatment takes place with the availability of serial heart rate measurements, ECG or ambulatory 24-hour monitoring.

The starting dose of Ivabradine should not exceed 5 mg twice daily in patients aged below 75 years. After three to four weeks of treatment, if the patient is still symptomatic, if the initial dose is well tolerated and if resting heart rate remains above 60 bpm, the dose may be increased to the next higher dose in patients receiving 2.5 mg twice daily or 5 mg twice daily. The maintenance dose should not exceed 7.5 mg twice daily.

If there is no improvement in symptoms of angina within 3 months after start of treatment, treatment of Ivabradine should be discontinued.

In addition, discontinuation of treatment should be considered if there is only limited symptomatic response and when there is no clinically relevant reduction in resting heart rate within three months.

If, during treatment, heart rate decreases below 50 beats per minute (bpm) at rest or the patient experiences symptoms related to bradycardia such as dizziness, fatigue or hypotension, the dose must be titrated downward including the lowest dose of 2.5 mg twice daily (one half 5 mg tablet twice daily). After dose reduction, heart rate should be monitored (see section 4.4). Treatment must be discontinued if heart rate remains below 50 bpm or symptoms of bradycardia persist despite dose reduction.

### *Treatment of chronic heart failure*

The treatment has to be initiated only in patient with stable heart failure. It is recommended that the treating physician should be experienced in the management of chronic heart failure.

The usual recommended starting dose of Ivabradine is 5 mg twice daily. After two weeks of treatment, the dose can be increased to 7.5 mg twice daily if resting heart rate is persistently above 60 bpm or decreased to 2.5 mg twice daily (one half 5 mg tablet twice daily) if resting heart rate is persistently below 50 bpm or in case of symptoms related to bradycardia such as dizziness, fatigue or hypotension. If heart rate is between 50 and 60 bpm, the dose of 5 mg twice daily should be maintained.

If during treatment, heart rate decreases persistently below 50 beats per minute (bpm) at rest or the patient experiences symptoms related to bradycardia, the dose must be titrated downward to the next lower dose in patients receiving 7.5 mg twice daily or 5 mg twice daily. If heart rate increases persistently above 60 beats per minute at rest, the dose can be up titrated to the next upper dose in patients receiving 2.5 mg twice daily or 5 mg twice daily.

Treatment must be discontinued if heart rate remains below 50 bpm or symptoms of bradycardia persist (see section 4.4).

## Special populations

### *Elderly*

In patients aged 75 years or more, a lower starting dose should be considered (2.5 mg twice daily i.e. one half 5 mg tablet twice daily) before up-titration if necessary.

### *Renal impairment*

No dose adjustment is required in patients with renal insufficiency and creatinine clearance above 15 mL/min (see section 5.2).

No data are available in patients with creatinine clearance below 15 mL/min. Ivabradine should therefore be used with precaution in this population.

### *Hepatic impairment*

No dose adjustment is required in patients with mild hepatic impairment. Caution should be exercised when using Ivabradine in patients with moderate hepatic impairment.

Ivabradine is contraindicated for use in patients with severe hepatic insufficiency, since it has not been studied in this population and a large increase in systemic exposure is anticipated (see sections 4.3 and 5.2).

### *Paediatric population*

The safety and efficacy of ivabradine in children aged below 18 years have not yet been established.

No data are available.

#### Method of administration

Tablets must be taken orally twice daily, i.e. once in the morning and once in the evening during meals (see section 5.2).

### **4.3 Contraindications**

- Hypersensitivity to the active substance or to any of the excipients listed in section 6.1
- Resting heart rate below 70 beats per minute prior to treatment
- Cardiogenic shock
- Acute myocardial infarction
- Severe hypotension (< 90/50 mmHg)
- Severe hepatic insufficiency
- Sick sinus syndrome
- Sino-atrial block
- Unstable or acute heart failure
- Pacemaker dependent (heart rate imposed exclusively by the pacemaker)
- Unstable angina
- AV-block of 3<sup>rd</sup> degree
- Combination with strong cytochrome P450 3A4 inhibitors such as azole antifungals (ketoconazole, itraconazole), macrolide antibiotics (clarithromycin, erythromycin *per os*, josamycin, telithromycin), HIV protease inhibitors (nelfinavir, ritonavir) and nefazodone (see sections 4.5 and 5.2)
- Combination with verapamil or diltiazem which are moderate CYP3A4 inhibitors with heart rate reducing properties (see section 4.5)
- Pregnancy, lactation and women of childbearing potential not using appropriate contraceptive measures (see section 4.6)

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

#### Lack of benefit on clinical outcomes in patients with symptomatic chronic stable angina pectoris

Ivabradine is indicated only for symptomatic treatment of chronic stable angina pectoris because Ivabradine has no benefits on cardiovascular outcomes, e.g. myocardial infarction or cardiovascular death (see section 5.1).

#### Measurement of heart rate

Given that the heart rate may fluctuate considerably over time, serial heart rate measurements, ECG or ambulatory 24-hour monitoring should be considered when determining resting heart rate before initiation of Ivabradine treatment and in patients on treatment with Ivabradine when titration is considered. This also applies to patients with a low heart rate, in particular when heart rate decreases below 50 bpm, or after dose reduction (see section 4.2).

#### Cardiac arrhythmias

Ivabradine is not effective in the treatment or prevention of cardiac arrhythmias and likely loses its efficacy when a tachyarrhythmia occurs (eg. ventricular or supraventricular tachycardia). Ivabradine is therefore not recommended in patients with atrial fibrillation or other cardiac arrhythmias that interfere with sinus node function.

In patients treated with Ivabradine the risk of developing atrial fibrillation is increased (see section 4.8). Atrial fibrillation has been more common in patients using concomitantly amiodarone or potent class I anti-arrhythmics. It is recommended to regularly clinically monitor Ivabradine treated patients for the

occurrence of atrial fibrillation (sustained or paroxysmal), which should also include ECG monitoring if clinically indicated (e.g. in case of exacerbated angina, palpitations, irregular pulse).

Patients should be informed of signs and symptoms of atrial fibrillation and be advised to contact their physician if these occur.

If atrial fibrillation develops during treatment, the balance of benefits and risks of continued Ivabradine treatment should be carefully reconsidered.

Chronic heart failure patients with intraventricular conduction defects (bundle branch block left, bundle branch block right) and ventricular dyssynchrony should be monitored closely.

#### Use in patients with AV-block of 2<sup>nd</sup> degree

Ivabradine is not recommended in patients with AV-block of 2<sup>nd</sup> degree.

#### Use in patients with a low heart rate

Ivabradine must not be initiated in patients with a pre-treatment resting heart rate below 70 beats per minute (bpm) (see section 4.3).

If, during treatment, resting heart rate decreases persistently below 50 bpm or the patient experiences symptoms related to bradycardia such as dizziness, fatigue or hypotension, the dose must be titrated downward or treatment discontinued if heart rate below 50 bpm or symptoms of bradycardia persist (see section 4.2).

#### Combination with calcium channel blockers

Concomitant use of Ivabradine with heart rate reducing calcium channel blockers such as verapamil or diltiazem is contraindicated (see sections 4.3 and 4.5). No safety issue has been raised on the combination of Ivabradine with nitrates and dihydropyridine calcium channel blockers such as amlodipine. Additional efficacy of Ivabradine in combination with dihydropyridine calcium channel blockers has not been established (see section 5.1).

#### Chronic heart failure

Heart failure must be stable before considering Ivabradine treatment. Ivabradine should be used with caution in heart failure patients with NYHA functional classification IV due to limited amount of data in this population.

#### Stroke

The use of Ivabradine is not recommended immediately after a stroke since no data is available in these situations.

#### Visual function

Ivabradine influences retinal function. There is no evidence of a toxic effect of long-term Ivabradine treatment on the retina (see section 5.1). Cessation of treatment should be considered if any unexpected deterioration in visual function occurs. Caution should be exercised in patients with retinitis pigmentosa.

#### Patients with hypotension

Limited data are available in patients with mild to moderate hypotension, and Ivabradine should therefore be used with caution in these patients. Ivabradine is contraindicated in patients with severe hypotension (blood pressure < 90/50 mmHg) (see section 4.3).

#### Atrial fibrillation - Cardiac arrhythmias

There is no evidence of risk of (excessive) bradycardia on return to sinus rhythm when pharmacological cardioversion is initiated in patients treated with Ivabradine. However, in the absence of extensive data, non urgent DC-cardioversion should be considered 24 hours after the last dose of Ivabradine.

#### Use in patients with congenital QT syndrome or treated with QT prolonging medicinal products

The use of Ivabradine in patients with congenital QT syndrome or treated with QT prolonging medicinal products should be avoided (see section 4.5). If the combination appears necessary, close cardiac monitoring is needed.

Heart rate reduction, as caused by Ivabradine, may exacerbate QT prolongation, which may give rise to severe arrhythmias, in particular Torsade de pointes.

#### Hypertensive patients requiring blood pressure treatment modifications.

When treatment modifications are made in chronic heart failure patients treated with Ivabradine, blood pressure should be monitored at an appropriate interval (see section 4.8).

#### Excipients

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

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

#### Pharmacodynamic interactions

##### *Concomitant use not recommended*

##### QT prolonging medicinal products

- Cardiovascular QT prolonging medicinal products (e.g. quinidine, disopyramide, bepridil, sotalol, ibutilide, amiodarone).
- Non cardiovascular QT prolonging medicinal products (e.g. pimozide, ziprasidone, sertindole, mefloquine, halofantrine, pentamidine, cisapride, intravenous erythromycin).

The concomitant use of cardiovascular and non cardiovascular QT prolonging medicinal products with Ivabradine should be avoided since QT prolongation may be exacerbated by heart rate reduction. If the combination appears necessary, close cardiac monitoring is needed (see section 4.4).

##### *Concomitant use with precaution*

##### Potassium-depleting diuretics (thiazide diuretics and loop diuretics)

Hypokalemia can increase the risk of arrhythmia. As Ivabradine may cause bradycardia, the resulting combination of hypokalemia and bradycardia is a predisposing factor to the onset of severe arrhythmias, especially in patients with long QT syndrome, whether congenital or substance-induced.

#### Pharmacokinetic interactions

Ivabradine is metabolised by CYP3A4 only and it is a very weak inhibitor of this cytochrome. Ivabradine was shown not to influence the metabolism and plasma concentrations of other CYP3A4 substrates (mild, moderate and strong inhibitors). CYP3A4 inhibitors and inducers are liable to interact with Ivabradine and influence its metabolism and pharmacokinetics to a clinically significant extent. Interaction studies have established that CYP3A4 inhibitors increase Ivabradine plasma concentrations, while inducers decrease them. Increased plasma concentrations of Ivabradine may be associated with the risk of excessive bradycardia (see section 4.4).

##### *Contraindication of concomitant use*

##### Potent CYP3A4 inhibitors

The concomitant use of potent CYP3A4 inhibitors such as azole antifungals (ketoconazole, itraconazole), macrolide antibiotics (clarithromycin, erythromycin per os, josamycin, telithromycin), HIV protease inhibitors (nelfinavir, ritonavir) and nefazodone is contraindicated (see section 4.3). The potent CYP3A4 inhibitors ketoconazole (200 mg once daily) and josamycin (1 g twice daily) increased Ivabradine mean plasma exposure by 7 to 8 fold.

##### Moderate CYP3A4 inhibitors

Specific interaction studies in healthy volunteers and patients have shown that the combination of Ivabradine with the heart rate reducing agents diltiazem or verapamil resulted in an increase in Ivabradine exposure (2 to 3 fold increase in AUC) and an additional heart rate reduction of 5 bpm. The concomitant use of Ivabradine with these medicinal products is contraindicated (see section 4.3).

##### *Concomitant use not recommended*

Ivabradine exposure was increased by 2-fold following the co-administration with grapefruit juice. Therefore the intake of grapefruit juice should be avoided.

#### *Concomitant use with precautions*

##### Moderate CYP3A4 inhibitors

The concomitant use of Ivabradine with other moderate CYP3A4 inhibitors (e.g. fluconazole) may be considered at the starting dose of 2.5 mg twice daily and if resting heart rate is above 70 bpm, with monitoring of heart rate.

##### CYP3A4 inducers

CYP3A4 inducers (e.g. rifampicin, barbiturates, phenytoin, Hypericum perforatum [St John's Wort]) may decrease Ivabradine exposure and activity. The concomitant use of CYP3A4 inducing medicinal products may require an adjustment of the dose of Ivabradine. The combination of Ivabradine 10 mg twice daily with St John's Wort was shown to reduce Ivabradine AUC by half. The intake of St John's Wort should be restricted during the treatment with Ivabradine.

#### *Other concomitant use*

Specific interaction studies have shown no clinically significant effect of the following medicinal products on pharmacokinetics and pharmacodynamics of Ivabradine: proton pump inhibitors (omeprazole, lansoprazole), sildenafil, HMG CoA reductase inhibitors (simvastatin), dihydropyridine calcium channel blockers (amlodipine, lacidipine), digoxin and warfarin. In addition there was no clinically significant effect of Ivabradine on the pharmacokinetics of simvastatin, amlodipine, lacidipine, on the pharmacokinetics and pharmacodynamics of digoxin, warfarin and on the pharmacodynamics of aspirin.

In pivotal phase III clinical trials the following medicinal products were routinely combined with Ivabradine with no evidence of safety concerns: angiotensin converting enzyme inhibitors, angiotensin II antagonists, beta-blockers, diuretics, anti-aldosterone agents, short and long acting nitrates, HMG CoA reductase inhibitors, fibrates, proton pump inhibitors, oral antidiabetics, aspirin and other antiplatelet medicinal products.

##### Paediatric population

Interaction studies have only been performed in adults.

## **4.6 Fertility, pregnancy and lactation**

##### Women of childbearing potential

Women of childbearing potential should use appropriate contraceptive measures during treatment (see section 4.3).

##### Pregnancy

There are no or limited amount of data from the use of Ivabradine in pregnant women. Studies in animals have shown reproductive toxicity. These studies have shown embryotoxic and teratogenic effects (see section 5.3). The potential risk for humans is unknown. Therefore, Ivabradine is contraindicated during pregnancy (see section 4.3).

##### Breast-feeding

Animal studies indicate that Ivabradine is excreted in milk. Therefore, Ivabradine is contraindicated during breast-feeding (see section 4.3).

Women that need treatment with Ivabradine should stop breast-feeding, and choose for another way of feeding their child.

##### Fertility

Studies in rats have shown no effect on fertility in males and females (see section 5.3).

#### 4.7 Effects on ability to drive and use machines

Ivabradine has no or negligible influence on the ability to use machines.

A specific study to assess the possible influence of Ivabradine on driving performance has been performed in healthy volunteers where no alteration of the driving performance was evidenced. However, in post-marketing experience, cases of impaired driving ability due to visual symptoms have been reported. Ivabradine may cause transient luminous phenomena consisting mainly of phosphenes (see section 4.8). The possible occurrence of such luminous phenomena should be taken into account when driving or using machines in situations where sudden variations in light intensity may occur, especially when driving at night.

#### 4.8 Undesirable effects

##### Summary of the safety profile

The most common adverse reactions with Ivabradine are luminous phenomena (phosphenes) (14.5%) and bradycardia (3.3%). They are dose dependent and related to the pharmacological effect of the medicinal product.

##### Tabulated list of adverse reactions

The following adverse reactions have been reported during clinical trials and are ranked using the following frequency:

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 ( $< 1/10,000$ ); not known (cannot be estimated from the available data).

| System Organ Class                              | Frequency   | Preferred Term  |
|---|-------------|---|
| Blood and lymphatic system disorders            | Uncommon    | Eosinophilia  |
| Metabolism and nutrition disorders              | Uncommon    | Hyperuricaemia  |
| Nervous system disorders                        | Common      | Headache, generally during the first month of treatment                 |
|   |             | Dizziness, possibly related to bradycardia                              |
|   | Uncommon*   | Syncope, possibly related to bradycardia                                |
| Eye disorders                                   | Very common | Luminous phenomena (phosphenes)   |
|   | Common      | Blurred vision  |
|   | Uncommon*   | Diplopia  |
|   |             | Visual impairment   |
| Ear and labyrinth disorders                     | Uncommon    | Vertigo   |
| Cardiac disorders                               | Common      | Bradycardia   |
|   |             | AV 1 <sup>st</sup> degree block (ECG prolonged PQ interval)             |
|   |             | Ventricular extrasystoles   |
|   |             | Atrial fibrillation   |
|   | Uncommon    | Palpitations, supraventricular extrasystoles, ECG prolonged QT interval |
|   | Very rare   | AV 2 <sup>nd</sup> degree block, AV 3 <sup>rd</sup> degree block        |
| Vascular disorders                              | Common      | Uncontrolled blood pressure   |
|   | Uncommon*   | Hypotension, possibly related to bradycardia                            |
| Respiratory, thoracic and mediastinal disorders | Uncommon    | Dyspnoea  |
| Gastrointestinal disorders                      | Uncommon    | Nausea  |
|   |             | Constipation  |
|   |             | Diarrhoea   |
|   |             | Abdominal pain*   |
| Skin and subcutaneous tissue disorders          | Uncommon*   | Angioedema  |

|  |           |   |
|--|-----------|---|
|  | Rare*     | Rash                                      |
|  |           | Erythema                                  |
|  |           | Pruritus                                  |
|  |           | Urticaria                                 |
| Musculoskeletal and connective tissue disorders      | Uncommon  | Muscle spasms                             |
| Renal and urinary disorders                          | Uncommon  | Elevated creatinine in blood              |
| General disorders and administration site conditions | Uncommon* | Asthenia, possibly related to bradycardia |
|  |           | Fatigue, possibly related to bradycardia  |
|  | Rare*     | Malaise, possibly related to bradycardia  |

\* Frequency calculated from clinical trials for adverse events detected from spontaneous report

#### Description of selected adverse reactions

Luminous phenomena (phosphenes) were reported by 14.5% of patients, described as a transient enhanced brightness in a limited area of the visual field. They are usually triggered by sudden variations in light intensity. Phosphenes may also be described as a halo, image decomposition (stroboscopic or kaleidoscopic effects), coloured bright lights, or multiple image (retinal persistency).

The onset of phosphenes is generally within the first two months of treatment after which they may occur repeatedly. Phosphenes were generally reported to be of mild to moderate intensity. All phosphenes resolved during or after treatment, of which a majority (77.5%) resolved during treatment. Fewer than 1% of patients changed their daily routine or discontinued the treatment in relation with phosphenes.

Bradycardia was reported by 3.3% of patients particularly within the first 2 to 3 months of treatment initiation. 0.5% of patients experienced a severe bradycardia below or equal to 40 bpm.

In the SIGNIFY study atrial fibrillation was observed in 5.3% of patients taking Ivabradine compared to 3.8% in the placebo group. In a pooled analysis of all the Phase II/III double blind controlled clinical trials with a duration of at least 3 months including more than 40,000 patients, the incidence of atrial fibrillation was 4.86% in Ivabradine treated patients compared to 4.08% in controls, corresponding to a hazard ratio of 1.26, 95% CI [1.15-1.39].

In the SHIFT trial more patients experienced episodes of increased blood pressure while treated with Ivabradine (7.1%) compared to patients treated with placebo (6.1%). These episodes occurred most frequently shortly after blood pressure treatment was modified, were transient, and did not affect the treatment effect of Ivabradine.

#### 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.

## **4.9 Overdose**

#### Symptoms

Overdose may lead to severe and prolonged bradycardia (see section 4.8).

#### Management

Severe bradycardia should be treated symptomatically in a specialised environment. In the event of bradycardia with poor haemodynamic tolerance, symptomatic treatment including intravenous betastimulating medicinal products such as isoprenaline may be considered. Temporary cardiac electrical pacing may be instituted if required.

## **5. PHARMACOLOGICAL PROPERTIES**

## 5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Cardiac therapy, other cardiac preparations, ATC code: C01EB17.

### Mechanism of action

Ivabradine is a pure heart rate lowering agent, acting by selective and specific inhibition of the cardiac pacemaker  $I_f$  current that controls the spontaneous diastolic depolarisation in the sinus node and regulates heart rate. The cardiac effects are specific to the sinus node with no effect on intra-atrial, atrioventricular or intraventricular conduction times, nor on myocardial contractility or ventricular repolarisation.

Ivabradine can interact also with the retinal current  $I_h$  which closely resembles cardiac  $I_f$ . It participates in the temporal resolution of the visual system, by curtailing the retinal response to bright light stimuli. Under triggering circumstances (e.g. rapid changes in luminosity), partial inhibition of  $I_h$  by Ivabradine underlies the luminous phenomena that may be occasionally experienced by patients. Luminous phenomena (phosphenes) are described as a transient enhanced brightness in a limited area of the visual field (see section 4.8).

### Pharmacodynamic effects

The main pharmacodynamic property of Ivabradine in humans is a specific dose dependent reduction in heart rate. Analysis of heart rate reduction with doses up to 20 mg twice daily indicates a trend towards a plateau effect which is consistent with a reduced risk of severe bradycardia below 40 bpm (see section 4.8).

At usual recommended doses, heart rate reduction is approximately 10 bpm at rest and during exercise. This leads to a reduction in cardiac workload and myocardial oxygen consumption. Ivabradine does not influence intracardiac conduction, contractility (no negative inotropic effect) or ventricular repolarisation:

- in clinical electrophysiology studies, Ivabradine had no effect on atrioventricular or intraventricular conduction times or corrected QT intervals;
- in patients with left ventricular dysfunction (left ventricular ejection fraction (LVEF) between 30 and 45%), Ivabradine did not have any deleterious influence on LVEF.

### Clinical efficacy and safety

The antianginal and anti-ischaemic efficacy of Ivabradine was studied in five double-blind randomised trials (three versus placebo, and one each versus atenolol and amlodipine). These trials included a total of 4,111 patients with chronic stable angina pectoris, of whom 2,617 received Ivabradine.

Ivabradine 5 mg twice daily was shown to be effective on exercise test parameters within 3 to 4 weeks of treatment. Efficacy was confirmed with 7.5 mg twice daily. In particular, the additional benefit over 5 mg twice daily was established in a reference-controlled study versus atenolol: total exercise duration at trough was increased by about 1 minute after one month of treatment with 5 mg twice daily and further improved by almost 25 seconds after an additional 3-month period with forced titration to 7.5 mg twice daily. In this study, the antianginal and anti-ischaemic benefits of Ivabradine were confirmed in patients aged 65 years or more. The efficacy of 5 and 7.5 mg twice daily was consistent across studies on exercise test parameters (total exercise duration, time to limiting angina, time to angina onset and time to 1 mm ST segment depression) and was associated with a decrease of about 70% in the rate of angina attacks. The twice-daily dosing regimen of Ivabradine gave uniform efficacy over 24 hours.

In an 889-patients randomised placebo-controlled study, Ivabradine given on top of atenolol 50 mg o.d. showed additional efficacy on all ETT parameters at the trough of drug activity (12 hours after oral intake).

In a 725-patients randomised placebo-controlled study, Ivabradine did not show additional efficacy on top of amlodipine 10 mg o.d. at the trough of drug activity (12 hours after oral intake) while an additional efficacy was shown at peak (3-4 hours after oral intake).

Ivabradine efficacy was fully maintained throughout the 3- or 4-month treatment periods in the efficacy trials. There was no evidence of pharmacological tolerance (loss of efficacy) developing during treatment nor of rebound phenomena after abrupt treatment discontinuation. The antianginal and anti-ischaemic effects of Ivabradine were associated with dose-dependent reductions in heart rate and with a significant decrease in rate pressure product (heart rate x systolic blood pressure) at rest and during exercise. The effects on blood pressure and peripheral vascular resistance were minor and not clinically significant.

A sustained reduction of heart rate was demonstrated in patients treated with Ivabradine for at least one year (n = 713). No influence on glucose or lipid metabolism was observed.

The antianginal and anti-ischaemic efficacy of Ivabradine was preserved in diabetic patients (n = 457) with a similar safety profile as compared to the overall population.

A large outcome study, BEAUTIFUL, was performed in 10917 patients with coronary artery disease and left ventricular dysfunction (LVEF<40%) on top of optimal background therapy with 86.9% of patients receiving beta-blockers. The main efficacy criterion was the composite of cardiovascular death, hospitalization for acute MI or hospitalization for new onset or worsening heart failure. The study showed no difference in the rate of the primary composite outcome in the Ivabradine group by comparison to the placebo group (relative risk Ivabradine: placebo 1.00, p=0.945).

In a post-hoc subgroup of patients with symptomatic angina at randomisation (n=1507), no safety signal was identified regarding cardiovascular death, hospitalization for acute MI or heart failure (Ivabradine 12.0% versus placebo 15.5%, p=0.05).

A large outcome study, SIGNIFY, was performed in 19102 patients with coronary artery disease and without clinical heart failure (LVEF > 40%), on top of optimal background therapy. A therapeutic scheme higher than the approved posology was used (starting dose 7.5 mg b.i.d. (5 mg b.i.d. if age ≥ 75 years) and titration up to 10 mg b.i.d.). The main efficacy criterion was the composite of cardiovascular death or non-fatal MI. The study showed no difference in the rate of the primary composite endpoint (PCE) in the Ivabradine group by comparison to the placebo group (relative risk Ivabradine/placebo 1.08, p=0.197). Bradycardia was reported by 17.9 % of patients in the Ivabradine group (2.1% in the placebo group). Verapamil, diltiazem or strong CYP 3A4 inhibitors were received by 7.1% of patients during the study.

A small statistically significant increase in the PCE was observed in a pre-specified subgroup of patients with angina patients in CCS class II or higher at baseline (n=12049) (annual rates 3.4% versus 2.9%, relative risk Ivabradine/placebo 1.18, p=0.018), but not in the subgroup of the overall angina population in CCS class ≥ I (n=14286) (relative risk Ivabradine/placebo 1.11, p=0.110).

The higher than approved dose used in the study did not fully explain these findings.

The SHIFT study was a large multicentre, international, randomised double-blind placebo controlled outcome trial conducted in 6505 adult patients with stable chronic CHF (for ≥ 4 weeks), NYHA class II to IV, with a reduced left ventricular ejection fraction (LVEF ≤ 35%) and a resting heart rate ≥ 70 bpm. Patients received standard care including beta-blockers (89 %), ACE inhibitors and/or angiotensin II antagonists (91 %), diuretics (83 %), and anti-aldosterone agents (60 %). In the Ivabradine group, 67% of patients were treated with 7.5 mg twice a day. The median follow-up duration was 22.9 months. Treatment with Ivabradine was associated with an average reduction in heart rate of 15 bpm from a baseline value of 80 bpm. The difference in heart rate between Ivabradine and placebo arms was 10.8 bpm at 28 days, 9.1 bpm at 12 months and 8.3 bpm at 24 months.

The study demonstrated a clinically and statistically significant relative risk reduction of 18% in the rate of the primary composite endpoint of cardiovascular mortality and hospitalisation for worsening heart failure (hazard ratio: 0.82, 95%CI [0.75;0.90] – p<0.0001) apparent within 3 months of initiation of treatment. The absolute risk reduction was 4.2%. The results on the primary endpoint are mainly driven by the heart failure endpoints, hospitalisation for worsening heart failure (absolute risk reduced by 4.7 %) and deaths from heart failure (absolute risk reduced by 1.1 %).

## Treatment effect on the primary composite endpoint, its components and secondary endpoints

|                                    | Ivabradine<br>(N=3241)<br>n (%) | Placebo<br>(N=3264)<br>n (%) | Hazard ratio<br>[95% CI] | p-value |
|------------------------------------|---------------------------------|------------------------------|--------------------------|---------|
| Primary composite endpoint         | 793 (24.47)                     | 937 (28.71)                  | 0.82 [0.75; 0.90]        | <0.0001 |
| Components of the composite:       |                                 |                              |                          |         |
| - CV death                         | 449 (13.85)                     | 491 (15.04)                  | 0.91 [0.80; 1.03]        | 0.128   |
| - Hospitalisation for worsening HF | 514 (15.86)                     | 672 (20.59)                  | 0.74 [0.66; 0.83]        | <0.0001 |
| Other secondary endpoints:         |                                 |                              |                          |         |
| - All cause death                  | 503 (15.52)                     | 552 (16.91)                  | 0.90 [0.80; 1.02]        | 0.092   |
| - Death from HF                    | 113 (3.49)                      | 151 (4.63)                   | 0.74 [0.58;0.94]         | 0.014   |
| - Hospitalisation for any cause    | 1231 (37.98)                    | 1356 (41.54)                 | 0.89 [0.82;0.96]         | 0.003   |
| - Hospitalisation for CV reason    | 977 (30.15)                     | 1122 (34.38)                 | 0.85 [0.78; 0.92]        | 0.0002  |

The reduction in the primary endpoint was observed consistently irrespective of gender, NYHA class, ischaemic or non-ischaemic heart failure aetiology and of background history of diabetes or hypertension.

In the subgroup of patients with HR  $\geq$  75 bpm (n=4150), a greater reduction was observed in the primary composite endpoint of 24 % (hazard ratio: 0.76, 95% CI [0.68;0.85] – p<0.0001) and for other secondary endpoints, including all cause death (hazard ratio: 0.83, 95%CI [0.72;0.96] – p=0.0109) and CV death (hazard ratio: 0.83, 95%CI [0.71;0.97] – p=0.0166). In this subgroup of patients, the safety profile of Ivabradine is in line with the one of the overall population.

A significant effect was observed on the primary composite endpoint in the overall group of patients receiving beta blocker therapy (hazard ratio: 0.85, 95%CI [0.76;0.94]). In the subgroup of patients with HR  $\geq$  75 bpm and on the recommended target dose of beta-blocker, no statistically significant benefit was observed on the primary composite endpoint (hazard ratio: 0.97, 95%CI [0.74;1.28]) and other secondary endpoints, including hospitalisation for worsening heart failure (hazard ratio: 0.79, 95% CI [0.56;1.10]) or death from heart failure (hazard ratio: 0.69, 95% CI [0.31;1.53]).

There was a significant improvement in NYHA class at last recorded value, 887 (28%) of patients on Ivabradine improved versus 776 (24%) of patients on placebo (p=0.001).

## 5.2 Pharmacokinetic properties

Under physiological conditions, Ivabradine is rapidly released from tablets and is highly water-soluble (>10 mg/mL). Ivabradine is the S-enantiomer with no bioconversion demonstrated *in vivo*. The N-desmethylated derivative of Ivabradine has been identified as the main active metabolite in humans.

### Absorption and bioavailability

Ivabradine is rapidly and almost completely absorbed after oral administration with a peak plasma level reached in about 1 hour under fasting condition. The absolute bioavailability of the film-coated tablets is around 40%, due to first-pass effect in the gut and liver.

Food delayed absorption by approximately 1 hour, and increased plasma exposure by 20 to 30 %. The intake of the tablet during meals is recommended in order to decrease intra-individual variability in exposure (see section 4.2).

### Distribution

Ivabradine is approximately 70% plasma protein bound and the volume of distribution at steady-state is close to 100 l in patients. The maximum plasma concentration following chronic administration at the recommended dose of 5 mg twice daily is 22 ng/mL (CV=29%). The average plasma concentration is 10 ng/mL (CV=38%) at steady-state.

### Biotransformation

Ivabradine is extensively metabolised by the liver and the gut by oxidation through cytochrome P450 3A4 (CYP3A4) only. The major active metabolite is the N-desmethylated derivative (S 18982) with an exposure about 40% of that of the parent compound. The metabolism of this active metabolite also involves CYP3A4. Ivabradine has low affinity for CYP3A4, shows no clinically relevant CYP3A4 induction or inhibition and is therefore unlikely to modify CYP3A4 substrate metabolism or plasma concentrations. Inversely, potent inhibitors and inducers may substantially affect Ivabradine plasma concentrations (see section 4.5).

### Elimination

Ivabradine is eliminated with a main half-life of 2 hours (70-75% of the AUC) in plasma and an effective half-life of 11 hours. The total clearance is about 400 mL/min and the renal clearance is about 70 mL/min. Excretion of metabolites occurs to a similar extent via faeces and urine. About 4% of an oral dose is excreted unchanged in urine.

### Linearity/non-linearity

The kinetics of Ivabradine is linear over an oral dose range of 0.5 – 24 mg.

### Special populations

#### *Elderly*

No pharmacokinetic differences (AUC and  $C_{max}$ ) have been observed between elderly ( $\geq 65$  years) or very elderly patients ( $\geq 75$  years) and the overall population (see section 4.2).

#### *Renal impairment*

The impact of renal impairment (creatinine clearance from 15 to 60 mL/min) on Ivabradine pharmacokinetic is minimal, in relation with the low contribution of renal clearance (about 20 %) to total elimination for both Ivabradine and its main metabolite S 18982 (see section 4.2).

#### *Hepatic impairment*

In patients with mild hepatic impairment (Child Pugh score up to 7) unbound AUC of Ivabradine and the main active metabolite was about 20% higher than in subjects with normal hepatic function. Data are insufficient to draw conclusions in patients with moderate hepatic impairment. No data are available in patients with severe hepatic impairment (see sections 4.2 and 4.3).

### Pharmacokinetic/pharmacodynamic (PK/PD) relationship

PK/PD relationship analysis has shown that heart rate decreases almost linearly with increasing Ivabradine and S 18982 plasma concentrations for doses of up to 15-20 mg twice daily. At higher doses, the decrease in heart rate is no longer proportional to Ivabradine plasma concentrations and tends to reach a plateau. High exposures to Ivabradine that may occur when Ivabradine is given in combination with strong CYP3A4 inhibitors may result in an excessive decrease in heart rate although this risk is reduced with moderate CYP3A4 inhibitors (see sections 4.3, 4.4 and 4.5). The PK/PD relationship of Ivabradine in paediatric chronic heart failure patients aged 6 months to less than 18 years is similar to the PK/PD relationship described in adults.

## **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, carcinogenic potential. Reproductive toxicity studies showed no effect of Ivabradine on fertility in male and female rats. When pregnant animals were treated during organogenesis at exposures close to therapeutic doses, there was a higher incidence of foetuses with cardiac defects in the rat and a small number of foetuses with ectrodactylia in the rabbit.

In dogs given Ivabradine (doses of 2, 7 or 24 mg/kg/day) for one year, reversible changes in retinal

function were observed but were not associated with any damage to ocular structures. These data are consistent with the pharmacological effect of Ivabradine related to its interaction with hyperpolarisation-activated  $I_h$  currents in the retina, which share extensive homology with the cardiac pacemaker  $I_f$  current. Other long-term repeat dose and carcinogenicity studies revealed no clinically relevant changes.

#### Environmental risk assessment (ERA)

The environmental risk assessment of Ivabradine has been conducted in accordance to European guidelines on ERA.

Outcomes of these evaluations support the lack of environmental risk of Ivabradine and Ivabradine does not pose a threat to the environment.

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

#### Tablet core

Cellulose, microcrystalline (E 460)

Lactose monohydrate

Croscarmellose sodium (E 468)

Silica, colloidal anhydrous (E 551)

Magnesium stearate (E 470b)

#### Film-coating

Hypromellose 6cp (E 464)

Titanium dioxide (E 171)

Macrogol 6000 (E 1521)

Magnesium stearate (E 470b)

Glycerol (E 422)

### **6.2 Incompatibilities**

Not applicable.

### **6.3 Shelf life**

Please refer to outer carton.

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

Please refer to outer carton.

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

Aluminium/Aluminium blisters

The blisters are subsequently packed into cardboard boxes.

#### Pack sizes

Packs containing 14 and 56 film-coated tablets.

Not all pack sizes may be marketed.

### **6.6 Special precautions for disposal**

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

**7. MANUFACTURER**

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18<sup>th</sup> km Marathonos Ave  
Pallini Attiki, 153 51  
Greece

**8. DATE OF REVISION OF THE TEXT**

03/2024