

## 1. NAME OF THE MEDICINAL PRODUCT

### **MEGAXIN® IV**

Solution for infusion

Moxifloxacin (as hydrochloride) 400 mg/250 ml

### **MEGAXIN® Tablets**

Film coated tablets

Moxifloxacin (as hydrochloride) 400 mg

## 2. QUALITATIVE AND QUANTITATIVE COMPOSITION

**2.1 MEGAXIN Tablets** are available as film-coated tablets containing moxifloxacin hydrochloride (equivalent to 400 mg moxifloxacin).

Excipient with known effect: The film-coated tablet contains 68 mg lactose monohydrate (= 66.56 mg lactose) (see section 4.4).

For the full list of excipients, see section 6.1.

**2.2 MEGAXIN IV** is available in glass bottle 250 ml colorless glass type 2 for infusion containing 400 mg of moxifloxacin, as a sterile, preservative free, 0.8% sodium chloride aqueous solution of moxifloxacin hydrochloride (containing 400 mg moxifloxacin) with pH ranging from 4.1 to 4.6.

For the full list of excipients, see section 6.1.

## 3. PHARMACEUTICAL FORM

### **MEGAXIN Tablets**

Oblong, dull red, film-coated tablets imprinted with “BAYER” on one side and “M400” on the other containing moxifloxacin hydrochloride (equivalent to 400 mg moxifloxacin).

### **MEGAXIN IV**

Ready-to-use 250 mL bottle for infusion, containing moxifloxacin hydrochloride (equivalent to 400 mg moxifloxacin) in 0.8% sodium chloride aqueous solution. The appearance of the intravenous solution is yellow. Discard the unused portion of the drug.

## 4. CLINICAL PARTICULARS

### **4.1 Therapeutic indications**

**MEGAXIN IV** is indicated for the treatment of adults (>18 years of age) with

Community Acquired Pneumonia caused by *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Mycoplasma pneumoniae* or *Chlamydia pneumoniae* and Complicated Skin and Skin Structure Infections caused by methicillin susceptible *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* or *Enterobacter cloacae*.

Appropriate culture and susceptibility tests should be performed before treatment in order to isolate and identify organisms causing infection and to determine their susceptibility to moxifloxacin. Therapy with MEGAXIN IV may be initiated before results of these tests are known; once results become available, appropriate therapy should be continued.

**MEGAXIN Tablets** is indicated for the treatment of the following bacterial infections in patients of 18 years and older

- Respiratory infections:
  - Uncomplicated Acute bacterial sinusitis (ABS).
  - Acute exacerbations of chronic bronchitis (AECB).

MEGAXIN Tablets should be used to treat adequately diagnosed ABS and AECB only when it is considered inappropriate to use antibacterial agents that are commonly recommended for the initial treatment of these infections or when these have failed to resolve the infection.

- Community- acquired pneumonia, except severe cases.

MEGAXIN Tablets should be used only when it is considered inappropriate to use antibacterial agents that are commonly recommended for the initial treatment of this infection.

- Community-acquired spontaneous and wound infections of the skin and skin structure.

Appropriate culture and susceptibility tests should be performed before treatment in order to isolate and identify organisms causing infection and to determine their susceptibility to moxifloxacin. Therapy with MEGAXIN Tablets may be initiated before results of these tests are known; once results become available, appropriate therapy should be continued.

Consideration should be given to official guidance on the appropriate use of antibacterial agents.

## 4.2 Posology and method of administration

### Dosage in Adult Patients

The dose of MEGAXIN is 400 mg (orally or as an intravenous infusion) once every 24 hours. The duration of therapy depends on the type of infection as described in Table 1.

**Table 1: Dosage and Duration of Therapy in Adult Patients**

| Type of Infection <sup>a</sup>                             | Dose<br>Every 24 hours | Duration <sup>b</sup><br>(days) |
|--|------------------------|---------------------------------|
| Acute Bacterial Sinusitis (ABS)                            | 400 mg                 | 10                              |
| Acute Bacterial Exacerbation of Chronic Bronchitis (ABECB) | 400 mg                 | 5                               |
| Community -Acquired Pneumonia                              | 400 mg                 | 7-14                            |
| Uncomplicated Skin and Skin Structure Infections (SSSI)    | 400 mg                 | 7                               |
| Complicated Skin and Skin Structure Infections (SSSI)      | 400 mg                 | 7-21                            |

a) Due to the designated pathogens [see *Therapeutic Indications (4.1)*].

b) Sequential therapy (intravenous to oral) may be instituted at the discretion of the physician

### *Conversion of Intravenous to Oral Dosing in Adults*

Intravenous formulation is indicated when it offers a route of administration advantageous to the patient (for example, patient cannot tolerate an oral dosage form). When switching from intravenous to oral formulation, no dosage adjustment is necessary. Patients whose therapy is started with MEGAXIN IV may be switched to MEGAXIN Tablets when clinically indicated at the discretion of the physician.

## Important Administration Instructions

### *MEGAXIN Tablets*

#### With Multivalent Cations

Administer MEGAXIN Tablets at least 4 hours before or 8 hours after products containing magnesium, aluminum, iron or zinc, including antacids, sucralfate, multivitamins and didanosine buffered tablets for oral suspension or the pediatric powder for oral solution [see *Interactions with medicinal Products (4.5)* and *Clinical Pharmacology (12.3)*].

#### With Food

MEGAXIN Tablets can be taken with or without food, drink fluids liberally.

### ***MEGAXIN IV Solution for Infusion***

Administer by Intravenous infusion only. It is not intended for intra-arterial, intramuscular, intrathecal, intraperitoneal, or subcutaneous administration.

Administer by intravenous infusion over a period of 60 minutes by direct infusion or through a Y-type intravenous infusion set which may already be in place. Avoid rapid or bolus intravenous infusion.

Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration, whenever solution and container permit.

Do not administer MEGAXIN IV if particulate matter and/or discoloration is observed.

Discard any unused portion because the glass bottles are for single-use only.

### **2.3 Drug and Diluent Compatibilities**

Because only limited data are available on the compatibility of MEGAXIN IV with other intravenous substances, additives or other medications should not be added to MEGAXIN IV or infused simultaneously through the same intravenous line. If the same intravenous line or a Y-type line is used for sequential infusion of other drugs, or if the “piggyback” method of administration is used, the line should be flushed before and after infusion of MEGAXIN IV with an infusion solution compatible with MEGAXIN IV as well as with other drug(s) administered via this common line.

Compatible Intravenous Solutions: MEGAXIN IV is compatible with the following intravenous solutions at ratios from 1:10 to 10:1:

0.9% Sodium Chloride Injection, USP  
1 Molar Sodium Chloride Injection  
5% Dextrose Injection, USP  
Sterile Water for Injection, USP  
10% Dextrose for Injection, USP  
Lactated Ringer’s for Injection

### **4.3 Contraindications**

- Hypersensitivity to moxifloxacin, other quinolones or to any of the excipients listed in section 6.1.
- Pregnancy and lactation (see section 4.6).
- Patients below 18 years of age.
- Patients with a history of tendon disease/disorder related to quinolone treatment.

Both in preclinical investigations and in humans, changes in cardiac electrophysiology have been observed following exposure to moxifloxacin, in the form of QT prolongation. For reasons of drug safety, moxifloxacin is therefore contraindicated in patients with:

- Congenital or documented acquired QT prolongation
- Electrolyte disturbances, particularly in uncorrected hypokalaemia
- Clinically relevant bradycardia
- Clinically relevant heart failure with reduced left-ventricular ejection fraction
- Previous history of symptomatic arrhythmias

Moxifloxacin should not be used concurrently with other drugs that prolong the QT interval (see also section 4.5).

Due to limited clinical data, moxifloxacin is also contraindicated in patients with impaired liver function

(Child Pugh C) and in patients with transaminases increase > 5fold ULN.

#### 4.4 Special warnings and precautions for use

The use of moxifloxacin should be avoided in patients who have experienced serious adverse reactions in the past when using quinolone or fluoroquinolone containing products (see section 4.8). Treatment of these patients with moxifloxacin should only be initiated in the absence of alternative treatment options and after careful benefit/risk assessment (see also section 4.3).

The benefit of moxifloxacin treatment especially in infections with a low degree of severity should be balanced with the information contained in the warnings and precautions section.

##### Prolongation of QTc interval and potentially QTc-prolongation-related clinical conditions

IV:

Moxifloxacin has been shown to prolong the QTc interval on the electrocardiogram in some patients. The magnitude of QT prolongation may increase with increasing plasma concentrations due to rapid intravenous infusion. Therefore, the duration of infusion should not be less than the recommended 60 minutes and the intravenous dose of 400 mg once a day should not be exceeded. For more details see below and refer to sections 4.3 and 4.5.

Treatment with moxifloxacin should be stopped if signs or symptoms that may be associated with cardiac arrhythmia occur during treatment, with or without ECG findings.

Moxifloxacin should be used with caution in patients with any condition pre-disposing to cardiac arrhythmias (e.g. acute myocardial ischaemia) because they may have an increased risk of developing ventricular arrhythmias (incl. torsade de pointes) and cardiac arrest. See also sections 4.3 and 4.5.

Moxifloxacin should be used with caution in patients who are taking medications that can reduce potassium levels. See also sections 4.3 and 4.5.

Moxifloxacin should be used with caution in patients who are taking medications associated with clinically significant bradycardia. See also section 4.3.

Female patients and elderly patients may be more sensitive to the effects of QTc-prolonging medications such as moxifloxacin and therefore special caution is required.

Tablets:

Moxifloxacin has been shown to prolong the QTc interval on the electrocardiogram in some patients. In the analysis of ECGs obtained in the clinical trial program, QTc prolongation with moxifloxacin was 6 msec  $\pm$  26 msec, 1.4% compared to baseline. As women tend to have a longer baseline QTc interval compared with men, they may be more sensitive to QTc-prolonging medications. Elderly patients may also be more susceptible to drug-associated effects on the QT interval.

Medication that can reduce potassium levels should be used with caution in patients receiving moxifloxacin (see also sections 4.3 and 4.5).

Moxifloxacin should be used with caution in patients with ongoing proarrhythmic conditions (especially women and elderly patients), such as acute myocardial ischaemia or QT prolongation as this may lead to an increased risk for ventricular arrhythmias (incl. torsade de pointes) and cardiac arrest (see also section 4.3). The magnitude of QT prolongation may increase with increasing concentrations of the drug. Therefore, the recommended dose should not be exceeded.

If signs of cardiac arrhythmia occur during treatment with moxifloxacin, treatment should be stopped and an ECG should be performed.

##### Hypersensitivity/allergic reactions

Hypersensitivity and allergic reactions have been reported for fluoroquinolones including moxifloxacin after first administration. Anaphylactic reactions can progress to a life-threatening shock, even after the first administration. In cases of clinical manifestations of severe hypersensitivity reactions moxifloxacin should be discontinued and suitable treatment (e.g. treatment for shock) initiated.

##### Severe liver disorders

Cases of fulminant hepatitis potentially leading to liver failure (including fatal cases) have been reported with moxifloxacin (see section 4.8). Patients should be advised to contact their doctor prior to continuing treatment if signs and symptoms of fulminant hepatic disease develop such as rapidly developing asthenia associated with jaundice, dark urine, bleeding tendency or hepatic encephalopathy. Liver function tests/investigations should be performed in cases where indications of liver dysfunction occur.

#### Severe cutaneous adverse reactions

Severe cutaneous adverse reactions (SCARs) including toxic epidermal necrolysis (TEN: also known as Lyell's syndrome), Stevens Johnson syndrome (SJS) and Acute Generalised Exanthematous Pustulosis (AGEP), which could be life-threatening or fatal, have been reported with moxifloxacin (see section 4.8). At the time of prescription, patients should be advised of the signs and symptoms of severe skin reactions and be closely monitored. If signs and symptoms suggestive of these reactions appear, moxifloxacin should be discontinued immediately, and an alternative treatment should be considered. If the patient has developed a serious reaction such as SJS, TEN or AGEP with the use of moxifloxacin, treatment with moxifloxacin must not be restarted in this patient at any time.

#### Central Nervous System Adverse Reactions - Seizures

Fluoroquinolones, including moxifloxacin, have been associated with an increased risk of seizures (convulsions), increased intracranial pressure (pseudotumor cerebri), dizziness, and tremors. Moxifloxacin, like other fluoroquinolones, is known to trigger seizures or lower the seizure threshold. Cases of status epilepticus have been reported. As with all fluoroquinolones, use moxifloxacin with caution in epileptic patients and patients with known or suspected CNS disorders that may predispose to seizures or lower the seizure threshold (for example, severe cerebral arteriosclerosis, previous history of convulsion, reduced cerebral blood flow, altered brain structure, or stroke), or in the presence of other risk factors that may predispose to seizures or lower the seizure threshold (for example, certain drug therapy, renal dysfunction). If seizures occur, discontinue moxifloxacin and institute appropriate care.

#### Prolonged, disabling and potentially irreversible serious adverse drug reactions

Very rare cases of prolonged (continuing months or years), disabling and potentially irreversible serious adverse drug reactions affecting different, sometimes multiple, body systems (musculoskeletal, nervous, psychiatric and senses) have been reported in patients receiving quinolones and fluoroquinolones irrespective of their age and pre-existing risk factors. Moxifloxacin should be discontinued immediately at the first signs or symptoms of any serious adverse reaction and patients should be advised to contact their prescriber for advice.

#### Peripheral neuropathy

Cases of sensory or sensorimotor polyneuropathy resulting in paraesthesia, hypaesthesia, dysaesthesia, or weakness have been reported in patients receiving quinolones and fluoroquinolones. Patients under treatment with moxifloxacin should be advised to inform their doctor prior to continuing treatment if symptoms of neuropathy such as pain, burning, tingling, numbness, or weakness develop in order to prevent the development of potentially irreversible condition (see section 4.8).

#### Central Nervous System Effects - Psychiatric Adverse Reactions

Fluoroquinolones, including moxifloxacin, have been associated with an increased risk of psychiatric adverse reactions, including: toxic psychosis, psychotic reactions progressing to suicidal ideations/thoughts, hallucinations, or paranoia; depression, or self-injurious behavior such as attempted or completed suicide; anxiety, agitation, or nervousness; confusion, delirium, disorientation, or disturbances in attention; insomnia or nightmares; memory impairment. These reactions may occur following the first dose. Advise patients receiving moxifloxacin to inform their healthcare provider immediately if these reactions occur, discontinue the drug, and institute appropriate care.

#### Antibiotic-associated diarrhoea incl. colitis

Antibiotic-associated diarrhoea (AAD) and antibiotic-associated colitis (AAC), including pseudomembranous colitis and *Clostridium difficile*-associated diarrhoea, has been reported in association with the use of broad spectrum antibiotics including moxifloxacin and may range in severity from mild diarrhoea to fatal colitis. Therefore it is important to consider this diagnosis in patients who develop serious diarrhoea during or after the use of moxifloxacin. If AAD or AAC is suspected or confirmed, ongoing treatment with antibacterial agents, including moxifloxacin, should be discontinued and adequate therapeutic measures should be initiated immediately. Furthermore, appropriate infection control measures should be undertaken to reduce the risk of

transmission. Drugs inhibiting peristalsis are contraindicated in patients who develop serious diarrhoea.

#### Patients with myasthenia gravis

Moxifloxacin should be used with caution in patients with myasthenia gravis because the symptoms can be exacerbated.

#### Tendinitis and tendon rupture

Tendinitis and tendon rupture (especially but not limited to Achilles tendon), sometimes bilateral, may occur as early as within 48 hours of starting treatment with quinolones and fluoroquinolones and have been reported to occur even up to several months after discontinuation of treatment (see sections 4.3 and 4.8). The risk of tendinitis and tendon rupture is increased in older patients, patients with renal impairment, patients with solid organ transplants, and those treated concurrently with corticosteroids.

Therefore, concomitant use of corticosteroids should be avoided.

At the first sign of tendinitis (e.g. painful swelling, inflammation) the treatment with moxifloxacin should be discontinued and alternative treatment should be considered. The affected limb(s) should be appropriately treated (e.g. immobilisation). Corticosteroids should not be used if signs of tendinopathy occur.

### Aortic aneurysm and dissection and heart valve regurgitation/incompetence

Epidemiologic studies report an increased risk of aortic aneurysm and dissection particularly in elderly patients, and of aortic and mitral valve regurgitation after intake of fluoroquinolones. Cases of aortic aneurysm and dissection, sometimes complicated by rupture (including fatal ones), and of regurgitation/incompetence of any of the heart valves have been reported in patients receiving fluoroquinolones (see section 4.8).

- Therefore, fluoroquinolones should only be used after careful benefit-risk assessment and after consideration of other therapeutic options in patients with positive family history of aneurysm disease, or congenital heart valve disease, or in patients diagnosed with pre-existing aortic aneurysm and/or aortic dissection or heart valve disease, or in presence of other risk factors or conditions predisposing for both aortic aneurysm and dissection and heart valve regurgitation/incompetence (e.g. connective tissue disorders such as Marfan syndrome or Ehlers-Danlos syndrome, Turner syndrome, Behçet's disease, hypertension, rheumatoid arthritis). or additionally
- for aortic aneurysm and dissection (e.g. vascular disorders such as Takayasu arteritis or giant cell arteritis, or known atherosclerosis, or Sjögren's syndrome) or additionally
- for heart valve regurgitation/incompetence (e.g. infective endocarditis).

The risk of aortic aneurysm and dissection, and their rupture may also be increased in patients treated concurrently with systemic corticosteroids.

In case of sudden abdominal, chest or back pain, patients should be advised to immediately consult a physician in an emergency department.

Patients should be advised to seek immediate medical attention in case of acute dyspnoea, new onset of heart palpitations, or development of oedema of the abdomen or lower extremities.

### Patients with renal impairment

Elderly patients with renal disorders should use moxifloxacin with caution if they are unable to maintain adequate fluid intake, because dehydration may increase the risk of renal failure.

### Vision disorders

If vision becomes impaired or any effects on the eyes are experienced, an eye specialist should be consulted immediately (see sections 4.7 and 4.8).

### Blood Glucose Disturbances

Fluoroquinolones, including moxifloxacin, have been associated with disturbances of blood glucose, including symptomatic hyperglycemia and hypoglycemia, usually in diabetic patients receiving concomitant treatment with an oral hypoglycemic agent (for example, glyburide) or with insulin. In these patients, careful monitoring of blood glucose is recommended. Severe cases of hypoglycemia resulting in coma or death have been reported. If a hypoglycemic reaction occurs in a patient being treated with moxifloxacin, discontinue moxifloxacin and initiate appropriate therapy immediately.

### Prevention of photosensitivity reactions

Quinolones have been shown to cause photosensitivity reactions in patients. However, studies have shown that moxifloxacin has a lower risk to induce photosensitivity. Nevertheless patients should be advised to avoid exposure to either UV irradiation or extensive and/or strong sunlight during treatment with moxifloxacin.

### Patients with glucose-6-phosphate dehydrogenase deficiency

Patients with a family history of or actual glucose-6-phosphate dehydrogenase deficiency are prone to haemolytic reactions when treated with quinolones. Therefore, moxifloxacin should be used with caution in these patients.



#### Peri-arterial tissue inflammation

Moxifloxacin solution for infusion is for intravenous administration only. Intra-arterial administration should be avoided since preclinical studies demonstrated peri-arterial tissue inflammation following infusion by this route.

#### Patients with pelvic inflammatory disease

For patients with complicated pelvic inflammatory disease (e.g. associated with a tubo-ovarian or pelvic abscess), for whom an intravenous treatment is considered necessary, treatment with Megaxin 400 mg film-coated tablets is not recommended.

Pelvic inflammatory disease may be caused by fluoroquinolone-resistant *Neisseria gonorrhoeae*. Therefore in such cases empirical moxifloxacin should be co-administered with another appropriate antibiotic (e.g. a cephalosporin) unless moxifloxacin-resistant *Neisseria gonorrhoeae* can be excluded. If clinical improvement is not achieved after 3 days of treatment, the therapy should be reconsidered.

#### Patients with special cSSSI

Clinical efficacy of intravenous moxifloxacin in the treatment of severe burn infections, fasciitis and diabetic foot infections with osteomyelitis has not been established.

#### Interference with biological tests

Moxifloxacin therapy may interfere with the *Mycobacterium* spp. culture test by suppression of mycobacterial growth causing false negative results in samples taken from patients currently receiving moxifloxacin.

### Patients with MRSA infections

Moxifloxacin is not recommended for the treatment of MRSA infections. In case of a suspected or confirmed infection due to MRSA, treatment with an appropriate antibacterial agent should be started (see section 5.1).

### Paediatric population

Due to adverse effects on the cartilage in juvenile animals (see section 5.3) the use of moxifloxacin in children and adolescents < 18 years is contraindicated (see section 4.3).

### Information about excipients

#### IV:

This medicinal product contains 787 mg (approximately 34 mmol) sodium per bottle with 250 ml solution for infusion, equivalent to 39.35 % of the WHO recommended maximum daily intake of 2 g sodium for an adult.

#### Tablets:

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

This medicine contains less than 1 mmol sodium (23 mg) per film-coated tablet, that is to say essentially “sodium-free”.

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

### Interactions with medicinal products

An additive effect on QT interval prolongation of moxifloxacin and other medicinal products that may prolong the QTc interval cannot be excluded. This might lead to an increased risk of ventricular arrhythmias, including torsade de pointes. Therefore, co-administration of moxifloxacin with any of the following medicinal products is contraindicated (see also section 4.3):

- anti-arrhythmics class IA (e.g. quinidine, hydroquinidine, disopyramide)
- anti-arrhythmics class III (e.g. amiodarone, sotalol, dofetilide, ibutilide)
- antipsychotics (e.g. phenothiazines, pimozide, sertindole, haloperidol, sultopride)
- tricyclic antidepressive agents
- certain antimicrobial agents (saquinavir, sparfloxacin, erythromycin IV, pentamidine, antimalarials particularly halofantrine)
- certain antihistaminics (terfenadine, astemizole, mizolastine)
- others (cisapride, vincamine IV, bepridil, diphemanil).

Moxifloxacin should be used with caution in patients who are taking medication that can reduce potassium levels (e.g. loop and thiazide-type diuretics, laxatives and enemas [high doses], corticosteroids, amphotericin B) or medication that is associated with clinically significant bradycardia.

For tablets only:

An interval of about 6 hours should be left between administration of agents containing bivalent or trivalent cations (e.g. antacids containing magnesium or aluminium, didanosine tablets, sucralfate and agents containing iron or zinc) and administration of moxifloxacin.

Concomitant administration of charcoal with an oral dose of 400 mg moxifloxacin led to a pronounced prevention of drug absorption and a reduced systemic availability of the drug by more than 80%. Therefore, the concomitant use of these two drugs is not recommended (except for overdose cases, see also section 4.9).

For IV and tablets:

After repeated dosing in healthy volunteers, moxifloxacin increased  $C_{max}$  of digoxin by approximately 30% without affecting AUC or trough levels. No precaution is required for use with digoxin.

In studies conducted in diabetic volunteers, concomitant administration of oral moxifloxacin with glibenclamide resulted in a decrease of approximately 21% in the peak plasma concentrations of glibenclamide. The combination of glibenclamide and moxifloxacin could theoretically result in a mild and transient hyperglycaemia. However, the observed pharmacokinetic changes for glibenclamide did not result in changes of the pharmacodynamic parameters (blood glucose, insulin). Therefore no clinically relevant interaction was observed between moxifloxacin and glibenclamide.

### *Changes in INR*

A large number of cases showing an increase in oral anticoagulant activity have been reported in patients receiving antibacterial agents, especially fluoroquinolones, macrolides, tetracyclines, cotrimoxazole and some cephalosporins. The infectious and inflammatory conditions, age and general status of the patient appear to be risk factors. Under these circumstances, it is difficult to evaluate whether the infection or the treatment caused the INR (international normalised ratio) disorder. A precautionary measure would be to more frequently monitor the INR. If necessary, the oral anticoagulant dosage should be adjusted as appropriate.

Clinical studies have shown no interactions following concomitant administration of moxifloxacin with: ranitidine, probenecid, oral contraceptives, calcium supplements, morphine administered parenterally, theophylline, cyclosporine or itraconazole.

*In vitro* studies with human cytochrome P450 enzymes supported these findings. Considering these results a metabolic interaction via cytochrome P450 enzymes is unlikely.

### Interaction with food

Moxifloxacin has no clinically relevant interaction with food including dairy products.

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

### Pregnancy

The safety of moxifloxacin in human pregnancy has not been evaluated. Animal studies have shown reproductive toxicity (see section 5.3). The potential risk for humans is unknown. Due to the experimental risk of damage by fluoroquinolones to the weight-bearing cartilage of immature animals and reversible joint injuries described in children receiving some fluoroquinolones, moxifloxacin must not be used in pregnant women (see section 4.3).

### Breastfeeding

There is no data available in lactating or nursing women. Preclinical data indicate that small amounts of moxifloxacin are secreted in milk. In the absence of human data and due to the experimental risk of damage by fluoroquinolones to the weight-bearing cartilage of immature animals, breast-feeding is contraindicated during moxifloxacin therapy (see section 4.3).

### Fertility

Animal studies do not indicate impairment of fertility (see section 5.3).

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

No studies on the effects of moxifloxacin on the ability to drive and use machines have been performed. However, fluoroquinolones including moxifloxacin may result in an impairment of the patient's ability to drive or operate machinery due to CNS reactions (e.g. dizziness; acute, transient loss of vision, see section 4.8) or acute and short lasting loss of consciousness (syncope, see section 4.8). Patients should be advised to see how they react to moxifloxacin before driving or operating machinery.

## **4.8 Undesirable effects**

### Tablets:

Adverse reactions based on all clinical trials and derived from post-marketing reports with moxifloxacin 400 mg (oral and sequential therapy) sorted by frequencies are listed below

### IV:

Adverse reactions observed in clinical trials and derived from post-marketing reports with moxifloxacin 400 mg daily administered by the intravenous or oral route (intravenous only, sequential [IV/oral] and oral administration) sorted by frequencies are listed below:

Apart from nausea and diarrhoea all adverse reactions were observed at frequencies below 3%.

Within each frequency grouping, undesirable effects are presented in order of decreasing seriousness.

Frequencies are defined as:

- 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)

| <b>System Organ Class (MedDRA)</b>          | <b>Common</b>   | <b>Uncommon</b>  | <b>Rare</b>  | <b>Very Rare</b>   | <b>Not known</b> |
|---|---|--|--|--|------------------|
| <b>Infections and infestations</b>          | Superinfections due to resistant bacteria or fungi<br>e.g. oral and vaginal candidiasis |  |  |  |                  |
| <b>Blood and lymphatic system disorders</b> |   | Anaemia<br>Leucopenia(s)<br>Neutropenia<br>Thrombocytopenia<br>Thrombocythemia<br>Blood eosinophilia<br>Prothrombin time prolonged/INR increased |  | Prothrombin level increased/INR decreased<br>Agranulocytosis<br>Pancytopenia   |                  |
| <b>Immune system disorders</b>              |   | Allergic reaction (see section 4.4)  | Anaphylaxis incl. very rarely life-threatening shock (see section 4.4)<br>Allergic oedema/angiooedema (incl. laryngeal oedema, potentially life-threatening, see section 4.4)                                      |  |                  |
| <b>Endocrine disorders</b>                  |   |  |  | Syndrome of inappropriate antidiuretic hormone secretion (SIADH)   |                  |
| <b>Metabolism and nutrition disorders</b>   |   | Hyperlipidemia   | Hyperglycemia<br>Hyperuricemia   | Hypoglycemia<br>Hypoglycaemic coma   |                  |
| <b>Psychiatric disorders*</b>               |   | Anxiety reactions<br>Psychomotor hyperactivity/agitation   | Emotional lability<br>Depression (in very rare cases potentially culminating in self-injurious behaviour, such as suicidal ideations/ thoughts, or suicide attempts, see section 4.4)<br>Hallucination<br>Delirium | Depersonalization<br>Psychotic reactions (potentially culminating in self-injurious behaviour, such as suicidal ideations/ thoughts, or suicide attempts, see section 4.4) |                  |

| <b>System Organ Class (MedDRA)</b>  | <b>Common</b>  | <b>Uncommon</b>  | <b>Rare</b>  | <b>Very Rare</b>   | <b>Not known</b> |
|-------------------------------------|--|--|--|--|------------------|
| <b>Nervous system disorders*</b>    | Headache<br>Dizziness  | Par- and<br>Dysaesthesia<br>Taste disorders<br>(incl. ageusia in<br>very rare cases)<br>Confusion and<br>disorientation<br>Sleep disorders<br>(predominantly<br>insomnia)<br>Tremor<br>Vertigo<br>Somnolence | Hypoaesthesia<br>Smell disorders<br>(incl. anosmia)<br>Abnormal<br>dreams<br>Disturbed<br>coordination<br>(incl. gait<br>disturbances, esp.<br>due to dizziness<br>or vertigo)<br>Seizures incl.<br>grand mal<br>convulsions (see<br>section 4.4)<br>Disturbed<br>attention<br>Speech disorders<br>Amnesia<br>Peripheral<br>neuropathy and<br>polyneuropathy | Hyperaesthesia   |                  |
| <b>Eye disorders*</b>               |  | Visual<br>disturbances<br>incl. diplopia<br>and blurred<br>vision<br>(especially in<br>the course of<br>CNS reactions,<br>see section<br>4.4)  | Photophobia  | Transient loss of<br>vision (especially<br>in the course of<br>CNS reactions,<br>see sections 4.4<br>and<br>4.7)<br>Uveitis and<br>bilateral acute<br>iris<br>transillumination<br>(see section 4.4) |                  |
| <b>Ear and labyrinth disorders*</b> |  |  | Tinnitus<br>Hearing<br>impairment<br>incl.<br>deafness<br>(usually<br>reversible)  |  |                  |
| <b>Cardiac disorders**</b>          | QT prolongation in<br>patients with<br>hypokalaemia (see<br>sections 4.3 and<br>4.4) | QT<br>prolongation<br>(see section<br>4.4)<br>Palpitations<br>Tachycardia<br>Atrial<br>fibrillation<br>Angina pectoris   | Ventricular<br>tachyarrhythmias<br>Syncope (i.e.,<br>acute and short<br>lasting loss of<br>consciousness)  | Unspecified<br>arrhythmias<br>Torsade de<br>Pointes (see<br>section 4.4)<br>Cardiac arrest<br>(see<br>section 4.4)   |                  |
| <b>Vascular disorders<br/>**</b>    |  | Vasodilatation   | Hypertension<br>Hypotension  | Vasculitis   |                  |

|  |  |   |  |  |  |
|--|--|---|--|--|--|
| <b>Respiratory,<br/>thoracic and<br/>mediastinal<br/>disorders</b> |  | Dyspnea<br>(including<br>asthmatic<br>conditions) |  |  |  |
|--|--|---|--|--|--|



| <b>System Organ Class (MedDRA)</b>                      | <b>Common</b>   | <b>Uncommon</b>  | <b>Rare</b>  | <b>Very Rare</b>  | <b>Not known</b>                                  |
|---|---|--|--|---|---|
| <b>Gastrointestinal disorders</b>                       | Nausea<br>Vomiting<br>Gastrointestinal and abdominal pains<br>Diarrhoea | Decreased appetite and food intake<br>Constipation<br>Dyspepsia<br>Flatulence<br>Gastritis<br>Increased amylase                                  | Dysphagia<br>Stomatitis<br>Antibiotic associated colitis (incl. pseudo-membranous colitis, in very rare cases associated with life-threatening complications, see section 4.4) |   |   |
| <b>Hepatobiliary disorders</b>                          | Increase in transaminases   | Hepatic impairment (incl. LDH increase)<br>Increased bilirubin<br>Increased gamma-glutamyl-transferase<br>Increase in blood alkaline phosphatase | Jaundice<br>Hepatitis (predominantly cholestatic)  | Fulminant hepatitis potentially leading to life-threatening liver failure (incl. fatal cases, see section 4.4)                      |   |
| <b>Skin and subcutaneous tissue disorders</b>           |   | Pruritus<br>Rash<br>Urticaria<br>Dry skin  |  | Bullous skin reactions like Stevens-Johnson syndrome or toxic epidermal necrolysis (potentially life-threatening, see section 4.4)  | Acute Generalised Exanthematous Pustulosis (AGEP) |
| <b>Musculoskeletal and connective tissue disorders*</b> |   | Arthralgia<br>Myalgia  | Tendonitis (see section 4.4)<br>Muscle cramp<br>Muscle twitching<br>Muscle weakness  | Tendon rupture (see section 4.4)<br>Arthritis<br>Muscle rigidity<br>Exacerbation of symptoms of myasthenia gravis (see section 4.4) | Rhabdomyolysis                                    |
| <b>Renal and urinary disorders</b>                      |   | Dehydration  | Renal impairment (incl. increase in BUN and creatinine)<br>Renal failure (see section 4.4)   |   |   |

|  |   |   |        |  |  |
|--|---|---|--------|--|--|
| <b>General disorders and administration site conditions*</b> | For IV only:<br>Injection and infusion site reactions | Feeling unwell (predominantly asthenia or fatigue)<br>Painful conditions (incl. pain in back, chest, pelvic and extremities)<br>Sweating for IV only:<br>Infusion site (thrombo-) phlebitis | Oedema |  |  |
|--|---|---|--------|--|--|

\*Very rare cases of prolonged (up to months or years), disabling and potentially irreversible serious drug reactions affecting several, sometimes multiple, system organ classes and senses (including reactions such as tendonitis, tendon rupture, arthralgia, pain in extremities, gait disturbance, neuropathies associated with paraesthesia, depression, fatigue, memory impairment, sleep disorders, and impairment of hearing, vision, taste and smell) have been reported in association with the use of quinolones and fluoroquinolones in some cases irrespective of pre-existing risk factors (see section 4.4).

\*\*Cases of aortic aneurysm and dissection, sometimes complicated by rupture (including fatal ones), and of regurgitation/incompetence of any of the heart valves have been reported in patients receiving fluoroquinolones (see section 4.4).

The following undesirable effects have a higher frequency category in the subgroup of IV treated patients with or without subsequent oral therapy:

Common: Increased gamma-glutamyl-transferase

Uncommon: Ventricular tachyarrhythmias, hypotension, oedema, antibiotic-associated colitis (incl. pseudomembranous colitis, in very rare cases associated with life-threatening complications, see section 4.4), seizures incl. grand mal convulsions (see section 4.4), hallucination, renal impairment (incl. increase in BUN and creatinine), renal failure (see section 4.4)

There have been very rare cases of the following side effects reported following treatment with other fluoroquinolones, which might possibly also occur during treatment with moxifloxacin: increased intracranial pressure (including pseudotumor cerebri), hypernatraemia, hypercalcaemia, haemolytic anaemia, photosensitivity reactions (see section 4.4).

#### Reporting of suspected adverse reactions

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

#### **4.9 Overdose**

No specific countermeasures after accidental overdose are recommended. In the event of overdose, symptomatic treatment should be implemented. ECG monitoring should be undertaken, because of the possibility of QT interval prolongation. Concomitant administration of charcoal with a dose of 400 mg oral or intravenous moxifloxacin will reduce systemic availability of the drug by more than 80% or 20% respectively. The use of charcoal early during absorption may be useful to prevent excessive increase in the systemic exposure to moxifloxacin in cases of oral overdose.

### **5. PHARMACOLOGICAL PROPERTIES**

#### **5.1 Pharmacodynamic properties**

Pharmacotherapeutic group: Quinolone antibacterials, fluoroquinolones, ATC code: J01MA14

#### Mechanism of action

Tablets:

Moxifloxacin has *in vitro* activity against a wide range of Gram-positive and Gram-negative pathogens. The bactericidal action of moxifloxacin results from the inhibition of both type II topoisomerases (DNA gyrase and topoisomerase IV) required for bacterial DNA replication, transcription and repair. It appears that the C8-methoxy moiety contributes to enhanced activity and lower selection of resistant mutants of Gram-positive bacteria compared to the C8-H moiety. The presence of the bulky bicycloamine substituent at the C-7 position prevents active efflux, associated with the *norA* or *pmrA* genes seen in certain Gram-positive bacteria. Pharmacodynamic investigations have demonstrated that moxifloxacin exhibits a concentration dependent killing rate. Minimum bactericidal concentrations (MBC) were found to be in the range of the minimum inhibitory concentrations (MIC).

#### Effect on the intestinal flora in humans

The following changes in the intestinal flora were seen in volunteers following oral administration of moxifloxacin: *Escherichia coli*, *Bacillus* spp., *Enterococcus* spp., and *Klebsiella* spp. were reduced, as were the anaerobes *Bacteroides vulgatus*, *Bifidobacterium* spp., *Eubacterium* spp., and *Peptostreptococcus* spp.. For *Bacteroides fragilis* there was an increase. These changes returned to normal within two weeks.

IV:

Moxifloxacin inhibits bacterial type II topoisomerases (DNA gyrase and topoisomerase IV) that are required for bacterial DNA replication, transcription and repair.

#### PK/PD

Fluoroquinolones exhibit a concentration dependent killing of bacteria. Pharmacodynamic studies of fluoroquinolones in animal infection models and in human trials indicate that the primary determinant of efficacy is the AUC<sub>24</sub>/MIC ratio.

## Mechanism of resistance

### IV:

Resistance to fluoroquinolones can arise through mutations in DNA gyrase and topoisomerase IV. Other mechanisms may include over-expression of efflux pumps, impermeability, and protein-mediated protection of DNA gyrase. Cross resistance should be expected between moxifloxacin and other fluoroquinolones. The activity of moxifloxacin is not affected by mechanisms of resistance that are specific to antibacterial agents of other classes

### Tablets:

Resistance mechanisms that inactivate penicillins, cephalosporins, aminoglycosides, macrolides and tetracyclines do not interfere with the antibacterial activity of moxifloxacin. Other resistance mechanisms such as permeation barriers (common in *Pseudomonas aeruginosa*) and efflux mechanisms may also effect susceptibility to moxifloxacin.

*In vitro* resistance to moxifloxacin is acquired through a stepwise process by target site mutations in both type II topoisomerases, DNA gyrase and topoisomerase IV. Moxifloxacin is a poor substrate for active efflux mechanisms in Gram-positive organisms.

Cross-resistance is observed with other fluoroquinolones. However, as moxifloxacin inhibits both topoisomerase II and IV with similar activity in some Gram-positive bacteria, such bacteria may be resistant to other quinolones, but susceptible to moxifloxacin.

### Breakpoints

EUCAST clinical MIC and disk diffusion breakpoints for moxifloxacin (01.01.2012):

| <b>Organism</b>   | <b>Susceptible</b>    | <b>Resistant</b>      |
|---|-----------------------|-----------------------|
| <i>Staphylococcus</i> spp.  | ≤ 0.5 mg/l<br>≥ 24 mm | > 1 mg/l<br>< 21 mm   |
| <i>S. pneumoniae</i>  | ≤ 0.5 mg/l<br>≥ 22 mm | > 0.5 mg/l<br>< 22 mm |
| <i>Streptococcus</i> Groups A, B, C, G  | ≤ 0.5 mg/l<br>≥ 18 mm | > 1 mg/l<br>< 15 mm   |
| <i>H. influenzae</i>  | ≤ 0.5 mg/l<br>≥ 25 mm | > 0.5 mg/l<br>< 25 mm |
| <i>M. catarrhalis</i>   | ≤ 0.5 mg/l<br>≥ 23 mm | > 0.5 mg/l<br>< 23 mm |
| <i>Enterobacteriaceae</i>   | ≤ 0.5 mg/l<br>≥ 20 mm | > 1 mg/l<br>< 17 mm   |
| Non-species related breakpoints*  | ≤ 0.5 mg/l            | > 1 mg/l              |
| * Non-species related breakpoints have been determined mainly on the basis of pharmacokinetic/pharmacodynamic data and are independent of MIC distributions of specific species. They are for use only for species that have not been given a species-specific breakpoint and are not for use with species where interpretative criteria remain to be determined. |                       |                       |

### Microbiological Susceptibility

The prevalence of acquired resistance may vary geographically and with time for selected species and local information of resistance is desirable, particularly when treating severe infections. As necessary, expert advice should be sought where the local prevalence of resistance is such that utility of the agent in at least some types of infections is questionable.

| <b>Commonly susceptible species</b>  |
|--|
| <p><u>Aerobic Gram-positive micro-organisms</u></p> <p><u>IV:</u><br/> <i>Staphylococcus aureus</i>*<sup>+++</sup><br/> <i>Streptococcus agalactiae</i> (Group B)<br/> <i>Streptococcus milleri</i> group* (<i>S. anginosus</i>, <i>S. constellatus</i> and <i>S. intermedius</i>)<br/> <i>Streptococcus pneumoniae</i>*<br/> <i>Streptococcus pyogenes</i>* (Group A)<br/> <i>Streptococcus viridans</i> group (<i>S. viridans</i>, <i>S. mutans</i>, <i>S. mitis</i>, <i>S. sanguinis</i>, <i>S. salivarius</i>, <i>S. thermophilus</i>)</p> <p><u>Tablets:</u><br/> <i>Gardnerella vaginalis</i><br/> <i>Staphylococcus aureus</i>* (methicillin-susceptible)<br/> <i>Streptococcus agalactiae</i> (Group B)<br/> <i>Streptococcus milleri</i> group* (<i>S. anginosus</i>, <i>S. constellatus</i> and <i>S. intermedius</i>)<br/> <i>Streptococcus pneumoniae</i>*<br/> <i>Streptococcus pyogenes</i>* (Group A)<br/> <i>Streptococcus viridans</i> group (<i>S. viridans</i>, <i>S. mutans</i>, <i>S. mitis</i>, <i>S. sanguinis</i>, <i>S. salivarius</i>, <i>S. thermophilus</i>)</p> |
| <p><u>Aerobic Gram-negative micro-organisms</u></p> <p><u>IV:</u><br/> <i>Acinetobacter baumannii</i><br/> <i>Haemophilus influenzae</i>*<br/> <i>Legionella pneumophila</i><br/> <i>Moraxella (Branhamella) catarrhalis</i>*</p> <p><u>Tablets:</u><br/> <i>Acinetobacter baumannii</i><br/> <i>Haemophilus influenzae</i>*<br/> <i>Haemophilus parainfluenzae</i>*<br/> <i>Legionella pneumophila</i><br/> <i>Moraxella (Branhamella) catarrhalis</i>*</p>   |
| <p><u>Anaerobic micro-organisms</u></p> <p><u>IV:</u><br/> <i>Prevotella</i> spp.</p> <p>Tablets:<br/> <i>Fusobacterium</i> spp.<br/> <i>Prevotella</i> spp.</p>   |
| <p><u>“Other” micro-organisms</u></p> <p><u>IV:</u><br/> <i>Chlamydophila (Chlamydia) pneumoniae</i>*<br/> <i>Coxiella burnetii</i><br/> <i>Mycoplasma pneumoniae</i>*</p> <p>Tablets:<br/> <i>Chlamydophila (Chlamydia) pneumoniae</i>*<br/> <i>Chlamydia trachomatis</i>*<br/> <i>Coxiella burnetii</i><br/> <i>Mycoplasma genitalium</i><br/> <i>Mycoplasma hominis</i><br/> <i>Mycoplasma pneumoniae</i>*</p>  |
| <p><b>Species for which acquired resistance may be a problem</b></p>   |
| <p><u>Aerobic Gram-positive micro-organisms</u></p> <p><u>IV:</u><br/> <i>Enterococcus faecalis</i>*<br/> <i>Enterococcus faecium</i>*</p> <p>Tablets:</p>   |

*Enterococcus faecalis*\*  
*Enterococcus faecium*\*  
*Staphylococcus aureus* (methicillin-resistant)<sup>†</sup>

Aerobic Gram-negative micro-organisms

IV:

*Enterobacter cloacae*\*  
*Escherichia coli*\*#  
*Klebsiella oxytoca*  
*Klebsiella pneumoniae*\*#  
*Proteus mirabilis*\*

Tablets:

*Enterobacter cloacae*\*  
*Escherichia coli*\*#  
*Klebsiella pneumoniae*\*#  
*Klebsiella oxytoca*  
*Neisseria gonorrhoeae*\*<sup>†</sup>  
*Proteus mirabilis*\*

Anaerobic micro-organisms

IV:

*Bacteroides fragilis*\*

Tablets:

*Bacteroides fragilis*\*  
*Peptostreptococcus* spp.\*

**Inherently resistant organisms**

Aerobic Gram-negative micro-organisms

*Pseudomonas aeruginosa*

\*Activity has been satisfactorily demonstrated in susceptible strains in clinical studies in the approved clinical indications.

<sup>††</sup>Methicillin resistant *S. aureus* have a high probability of resistance to fluoroquinolones.

Moxifloxacin resistance rate of > 50% have been reported for methicillin resistant *S. aureus*.

#ESBL-producing strains are commonly resistant to fluoroquinolones

<sup>†</sup>Resistance rate > 50% in one or more countries

## 5.2 Pharmacokinetic properties

### Absorption and Bioavailability

#### IV:

After a single 400 mg intravenous 1 hour infusion peak plasma concentrations of approximately 4.1 mg/l were observed at the end of the infusion corresponding to a mean increase of approximately 26% relative to those seen after oral administration (3.1 mg/l). The AUC value of approximately 39 mg·h/l after i.v. administration is only slightly higher than that observed after oral administration (35 mg·h/l) in accordance with the absolute bioavailability of approximately 91%.

In patients, there is no need for age or gender related dose adjustment on intravenous moxifloxacin.

Pharmacokinetics are linear in the range of 50 - 1200 mg single oral dose, up to 600 mg single intravenous dose and up to 600 mg once daily dosing over 10 days.

#### Tablets:

Following oral administration moxifloxacin is rapidly and almost completely absorbed. The absolute bioavailability amounts to approximately 91%.

Pharmacokinetics are linear in the range of 50 - 800 mg single dose and up to 600 mg once daily dosing over 10 days. Following a 400 mg oral dose peak concentrations of 3.1 mg/l are reached within 0.5 - 4 h post administration. Peak and trough plasma concentrations at steady-state (400 mg once daily) were 3.2 and 0.6 mg/l, respectively. At steady-state the exposure within the dosing interval is approximately 30% higher than after the first dose.

### Distribution

#### IV:

Moxifloxacin is distributed to extravascular spaces rapidly. The steady-state volume of distribution ( $V_{ss}$ ) is approximately 2 l/kg. *In vitro* and *ex vivo* experiments showed a protein binding of approximately 40 - 42% independent of the concentration of the drug. Moxifloxacin is mainly bound to serum albumin.

Maximum concentrations of 5.4 mg/kg and 20.7 mg/l (geometric mean) were reached in bronchial mucosa and epithelial lining fluid, respectively, 2.2 h after an oral dose. The corresponding peak concentration in alveolar macrophages amounted to 56.7 mg/kg. In skin blister fluid concentrations of 1.75 mg/l were observed 10 h after intravenous administration. In the interstitial fluid unbound concentration time profiles similar to those in plasma were found with unbound peak concentrations of 1.0 mg/l (geometric mean) reached approximately 1.8 h after an intravenous dose.

#### Tablets:

Moxifloxacin is distributed to extravascular spaces rapidly; after a dose of 400 mg an AUC of 35 mg·h/l is observed. The steady-state volume of distribution ( $V_{ss}$ ) is approximately 2 l/kg. *In vitro* and *ex vivo* experiments showed a protein binding of approximately 40 - 42% independent of the concentration of the drug. Moxifloxacin is mainly bound to serum albumin.

The following peak concentrations (geometric mean) were observed following administration of a single oral dose of 400 mg moxifloxacin:

| Tissue                  | Concentration           | Site: Plasma ratio       |
|-------------------------|-------------------------|--------------------------|
| Plasma                  | 3.1 mg/l                | -                        |
| Saliva                  | 3.6 mg/l                | 0.75 - 1.3               |
| Blister fluid           | 1.6 <sup>1</sup> mg/l   | 1.7 <sup>1</sup>         |
| Bronchial mucosa        | 5.4 mg/kg               | 1.7 - 2.1                |
| Alveolar macrophages    | 56.7 mg/kg              | 18.6 - 70.0              |
| Epithelial lining fluid | 20.7 mg/l               | 5 - 7                    |
| Maxillary sinus         | 7.5 mg/kg               | 2.0                      |
| Ethmoid sinus           | 8.2 mg/kg               | 2.1                      |
| Nasal polyps            | 9.1 mg/kg               | 2.6                      |
| Interstitial fluid      | 1.0 <sup>2</sup> mg/l   | 0.8 - 1.4 <sup>2,3</sup> |
| Female genital tract*   | 10.2 <sup>4</sup> mg/kg | 1.72 <sup>4</sup>        |

\* intravenous administration of a single 400 mg dose

<sup>1</sup> 10 h after administration

<sup>2</sup> unbound concentration

<sup>3</sup> from 3 h up to 36 h post dose

<sup>4</sup> at the end of infusion

### Biotransformation

Moxifloxacin undergoes Phase II biotransformation and is excreted via renal (for IV - approximately 40%) and biliary/faecal (for IV approximately 60%) pathways as unchanged drug as well as in the form of a sulpho-compound (M1) and a glucuronide (M2). M1 and M2 are the only metabolites relevant in humans, both are microbiologically inactive.

In clinical Phase I and *in vitro* studies no metabolic pharmacokinetic interactions with other drugs undergoing Phase I biotransformation involving cytochrome P450 enzymes were observed. There is no indication of oxidative metabolism.

### Elimination

#### IV:

Moxifloxacin is eliminated from plasma with a mean terminal half-life of approximately 12 hours. The mean apparent total body clearance following a 400 mg dose ranges from 179 to 246 ml/min. Following a 400 mg intravenous infusion recovery of unchanged drug from urine was approximately 22% and from faeces approximately 26%. Recovery of the dose (unchanged drug and metabolites) totalled to approximately 98% after intravenous administration of the drug. Renal clearance amounted to about 24 - 53 ml/min suggesting partial tubular reabsorption of the drug from the kidneys. Concomitant administration of moxifloxacin with ranitidine or probenecid did not alter renal clearance of the parent drug.

#### Tablets:

Moxifloxacin is eliminated from plasma with a mean terminal half life of approximately 12 hours. The mean apparent total body clearance following a 400 mg dose ranges from 179 to 246 ml/min. Renal clearance amounted to about 24 - 53 ml/min suggesting partial tubular reabsorption of the drug from the kidneys.

After a 400 mg dose, recovery from urine (approximately 19% for unchanged drug, approximately 2.5% for M1, and approximately 14% for M2) and faeces (approximately 25% of unchanged drug, approximately 36% for M1, and no recovery for M2) totalled to approximately 96%.

Concomitant administration of moxifloxacin with ranitidine or probenecid did not alter renal clearance of the parent drug.



#### *Elderly and patients with low body weight*

Higher plasma concentrations are observed in healthy volunteers with low body weight (such as women) and in elderly volunteers.

#### *Renal impairment*

The pharmacokinetic properties of moxifloxacin are not significantly different in patients with renal impairment (including creatinine clearance  $> 20$  ml/min/1.73 m<sup>2</sup>). As renal function decreases, concentrations of the M2 metabolite (glucuronide) increase by up to a factor of 2.5 (with a creatinine clearance of  $< 30$  ml/min/1.73 m<sup>2</sup>).

#### *Hepatic impairment*

On the basis of the pharmacokinetic studies carried out so far in patients with liver failure (Child Pugh A, B), it is not possible to determine whether there are any differences compared with healthy volunteers. Impaired liver function was associated with higher exposure to M1 in plasma, whereas exposure to parent drug was comparable to exposure in healthy volunteers. There is insufficient experience in the clinical use of moxifloxacin in patients with impaired liver function.

### **5.3 Preclinical safety data**

#### **IV:**

In conventional repeated dose studies moxifloxacin revealed haematological and hepatic toxicity in rodents and non-rodents. Toxic effects on the CNS were observed in monkeys. These effects occurred after the administration of high doses of moxifloxacin or after prolonged treatment.

In dogs, high oral doses ( $\geq 60$  mg/kg) leading to plasma concentrations  $\geq 20$  mg/l caused changes in the electroretinogram and in isolated cases an atrophy of the retina.

After intravenous administration findings indicative of systemic toxicity were most pronounced when moxifloxacin was given by bolus injection (45 mg/kg) but they were not observed when moxifloxacin (40 mg/kg) was given as slow infusion over 50 minutes.

After intra-arterial injection inflammatory changes involving the peri-arterial soft tissue were observed suggesting that intra-arterial administration of moxifloxacin should be avoided.

Moxifloxacin was genotoxic in *in vitro* tests using bacteria or mammalian cells. In *in vivo* tests, no evidence of genotoxicity was found despite the fact that very high moxifloxacin doses were used. Moxifloxacin was non-carcinogenic in an initiation-promotion study in rats.

*In vitro*, moxifloxacin revealed cardiac electrophysiological properties that can cause prolongation of the QT interval, even though at high concentrations.

After intravenous administration of moxifloxacin to dogs (30 mg/kg infused over 15, 30 or 60 minutes) the degree of QT prolongation was clearly depending on the infusion rate, i.e. the shorter the infusion time the more pronounced the prolongation of the QT interval. No prolongation of the QT interval was seen when a dose of 30 mg/kg was infused over 60 minutes.

Reproductive studies performed in rats, rabbits and monkeys indicate that placental transfer of moxifloxacin occurs. Studies in rats (p.o. and i.v.) and monkeys (p.o.) did not show evidence of teratogenicity or impairment of fertility following administration of moxifloxacin. A slightly increased incidence of vertebral and rib malformations was observed in fetuses of rabbits but only at a dose (20 mg/kg i.v.) which was associated with severe maternal toxicity. There was an increase in the incidence of abortions in monkeys and rabbits at human therapeutic plasma concentrations.

Quinolones, including moxifloxacin, are known to cause lesions in the cartilage of the major diarthrodial joints in immature animals.

#### Tablets:

Effects on the haematopoietic system (slight decreases in the number of erythrocytes and platelets) were seen in rats and monkeys. As with other quinolones, hepatotoxicity (elevated liver enzymes and vacuolar degeneration) was seen in rats, monkeys and dogs. In monkeys CNS toxicity (convulsions) occurred. These effects were seen only after treatment with high doses of moxifloxacin or after prolonged treatment.

Moxifloxacin, like other quinolones, was genotoxic in *in vitro* tests using bacteria or mammalian cells. Since these effects can be explained by an interaction with the gyrase in bacteria and - at higher concentrations - by an interaction with the topoisomerase II in mammalian cells, a threshold concentration for genotoxicity can be assumed. In *in vivo* tests, no evidence of genotoxicity was found despite the fact that very high moxifloxacin doses were used. Thus, a sufficient margin of safety to the therapeutic dose in man can be provided. Moxifloxacin was non-carcinogenic in an initiation-promotion study in rats.

Many quinolones are photoreactive and can induce phototoxic, photomutagenic and photocarcinogenic effects. In contrast, moxifloxacin was proven to be devoid of phototoxic and photogenotoxic properties when tested in a comprehensive programme of *in vitro* and *in vivo* studies. Under the same conditions other quinolones induced effects.

At high concentrations, moxifloxacin is an inhibitor of the rapid component of the delayed rectifier potassium current of the heart and may thus cause prolongations of the QT interval. Toxicological studies performed in dogs using oral doses of  $\geq 90$  mg/kg leading to plasma concentrations  $\geq 16$  mg/l caused QT prolongations, but no arrhythmias. Only after very high cumulative intravenous administration of more than 50fold the human dose ( $> 300$  mg/kg), leading to plasma concentrations of  $\geq 200$  mg/l (more than 40fold the therapeutic level), reversible, non-fatal ventricular arrhythmias were seen.

Quinolones are known to cause lesions in the cartilage of the major diarthrodial joints in immature animals. The lowest oral dose of moxifloxacin causing joint toxicity in juvenile dogs was four times the maximum recommended therapeutic dose of 400 mg (assuming a 50 kg bodyweight) on a mg/kg basis, with plasma concentrations two to three times higher than those at the maximum therapeutic dose.

Toxicity tests in rats and monkeys (repeated dosing up to six months) revealed no indication regarding an oculotoxic risk. In dogs, high oral doses ( $\geq 60$  mg/kg) leading to plasma concentrations  $\geq 20$  mg/l caused changes in the electroretinogram and in isolated cases an atrophy of the retina.

Reproductive studies performed in rats, rabbits and monkeys indicate that placental transfer of moxifloxacin occurs. Studies in rats (p.o. and i.v.) and monkeys (p.o.) did not show evidence of teratogenicity or impairment of fertility following administration of moxifloxacin. A slightly increased incidence of vertebral and rib malformations was observed in foetuses of rabbits but only at a dose (20 mg/kg i.v.) which was

associated with severe maternal toxicity. There was an increase in the incidence of abortions in monkeys and rabbits at human therapeutic plasma concentrations. In rats, decreased foetal weights, an increased prenatal loss, a slightly increased duration of pregnancy and an increased spontaneous activity of some male and female offspring was observed at doses which were 63 times the maximum recommended dose on a mg/kg basis with plasma concentrations in the range of the human therapeutic dose.

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

#### **MEGAXIN Tablets:**

The inactive ingredients are microcrystalline cellulose, lactose monohydrate, croscarmellose sodium, magnesium stearate, hypromellose 15 cP, titanium dioxide, macrogol 4000 and ferric oxide red.

#### **MEGAXIN IV:**

The inactive ingredients are Water for Injection, sodium chloride, and may include hydrochloric acid 1N and/or sodium hydroxide solution 2N for pH adjustment.

MEGAXIN IV contains approximately 34.2 mEq (787 mg) of sodium in 250 mL.

### **6.2 Incompatibilities**

IV: The following solutions are incompatible with moxifloxacin solution for infusion:

Sodium chloride 10% and 20% solutions

Sodium bicarbonate 4.2% and 8.4% solutions

This medicinal product must not be mixed with other medicinal products except those mentioned in section 6.6.

Tablets: Not applicable.

### **6.3 Shelf life**

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

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

**MEGAXIN Tablets:** Store below 25°C; store in the original package in order to protect from moisture.

**MEGAXIN IV:** Do not store below 15°C.

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

**MEGAXIN Tablets** are available in PP/Aluminium foil blisters in cartons of 5, 7, 10 film-coated tablets.

Not all pack sizes may be marketed.

**MEGAXIN IV** in sodium chloride injection is available as infusion bottles 250 ml of colourless glass (type 2) sealed with chlorbutyl grey mat with foil-clad PTFE siliconized type 1 or Bromobutyl gray siliconized type 1 or Bromobutyl gray mat siliconized type 1 infusion stoppers and containing 400 mg of moxifloxacin in 0.8% saline.

## **NO FURTHER DILUTION OF THIS PREPARATION IS NECESSARY.**

Parenteral drug products should be inspected visually for particulate matter prior to administration. Samples containing visible particulates should not be used. Because the containers are for single-use only, any unused portion should be discarded.

Not all pack sizes may be marketed.

### **6.6 Special precautions for disposal and other handling**

IV: This product is for single use only. Any unused solution should be discarded.

The following co-infusions were found to be compatible with moxifloxacin 400 mg solution for infusion:

Water for injections, Sodium chloride 0.9%, Sodium chloride 1 molar, Glucose 5%/10%/40%, Xylitol 20%, Ringer's solution, Compound Sodium Lactate Solution (Hartmann's Solution, Ringer-Lactate Solution).

Moxifloxacin solution for infusion should not be co-infused with other drugs.

Do not use if there are any visible particulate matter or if the solution is cloudy.

At cool storage temperatures precipitation may occur, which will re-dissolve at room temperature. It is therefore recommended not to store the infusion solution below 15°C.

Tablets: No special requirements.

## **7. MARKETING AUTHORISATION HOLDER**

Bayer Israel Ltd, 36 Hacharash St., Hod Hasharon 45240.

## **8. MANUFACTURER:**

Bayer AG, Leverkusen, Germany.

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

Megaxin tablet - 117 77 29884 01/02

Megaxin IV – 126 36 30540 00/01

Revised on Aug 2021 according to MoH guidelines