

Summary of Product Characteristics

1 NAME OF THE MEDICINAL PRODUCT

Floxapen 1000 mg powder for solution for injection/infusion

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each vial contains 1000 mg flucloxacillin (as flucloxacillin sodium).

Each 1000 mg vial contains approximately 51 mg (2.2 mmol) sodium.

For the full list of excipients, see section 6.1.

3 PHARMACEUTICAL FORM

Powder for solution for injection/infusion.

White to off-white powder for solution for injection/infusion.

4 CLINICAL PARTICULARS

4.1 Therapeutic indications

Flucloxacillin is indicated for the treatment of the following infections when caused by susceptible organisms, in particular *Staphylococcus aureus* (see sections 4.2 and 5.1).

Skin and soft tissue infections

Abscesses, cellulitis.

Respiratory tract infections

Lower respiratory tract infections: lung abscess, pneumonia.

Bone and joint infections

Arthritis, osteomyelitis.

Endocarditis.

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

4.2 Posology and method of administration

Posology

Adults and adolescents over 12 years of age:

Total daily dosage of 1 g – 6 g administered in 3-6 divided doses, by i.v. or i.m. injection.

In cases of severe infections: Up to 8 g per day administered in three to four infusions (over 20 to 30 min).

No intramuscular single bolus injection should exceed 2 g.

The maximum dose of 12 g per day should not be exceeded.

Paediatric population

Children under 12 years of age

25 to 50 mg/kg/24 hours administered in three to four equally divided doses by i.m. or i.v. injection.

In cases of severe infections: Up to 100 mg/kg/24 hours in three to four divided doses.

No single bolus injection or infusion should exceed 33 mg/kg.

Children aged 10 to 14 years usually receive a daily dose of 1.5 g to 2 g and children aged 6 to 10 years 0.75 g to 1.5 g, divided into three to four equal doses.

Other pharmaceutical forms/strengths may be more appropriate for administration to this population.

Premature infants, neonates, sucklings and infants

Other pharmaceutical forms/strengths may be more appropriate for administration to this population.

Abnormal renal function

In patients with renal insufficiency, excretion of flucloxacillin is slowed. In the presence of severe renal insufficiency (creatinine clearance <10 ml/min) a reduction in dose or an extension of dose interval should be considered. The maximum recommended dose in adults is 1 g every 8 to 12 hours.

Flucloxacillin is not significantly removed by dialysis and hence no supplementary dosages need be administered either during, or at the end of the dialysis period.

Hepatic impairment

Dose reduction in patients with reduced hepatic function is not necessary.

Method of administration

Flucloxacillin powder for solution for injection can be administered as intravenous (i.v.) or intramuscular (i.m.) injection and infusion.

For instructions on the preparation of solution see section 6.6.

4.3 Contraindications

- Flucloxacillin should not be given to patients with a history of hypersensitivity to beta-lactam antibiotics (e.g. penicillins, cephalosporins).
- Flucloxacillin is contraindicated in patients with a previous history of flucloxacillin-associated jaundice/hepatic dysfunction.
- Ocular or subconjunctival administration.

4.4 Special warnings and precautions for use

Before initiating therapy with flucloxacillin, careful inquiry should be made concerning previous hypersensitivity reactions to beta-lactams. Cross-sensitivity between penicillins and cephalosporins is well documented.

Serious and occasionally fatal hypersensitivity reactions (anaphylaxis) have been reported in patients receiving beta-lactam antibiotics. Although anaphylaxis is more frequent following parenteral therapy, it has occurred in patients on oral therapy. These reactions are more likely to occur in individuals with a history of beta-lactam hypersensitivity. If an allergic reaction occurs, flucloxacillin should be discontinued and the appropriate therapy instituted. Serious anaphylactoid reactions may require immediate emergency treatment with adrenaline. Oxygen, i.v. steroids, and airway management, including intubation, may also be required.

The occurrence at the treatment initiation of a feverish generalised erythema associated with pustula may be a symptom of acute generalised exanthematous pustulosis (AGEP) (see section 4.8). In case of AGEP diagnosis, flucloxacillin should be discontinued and any subsequent administration of flucloxacillin is contra-indicated.

Flucloxacillin should be used with caution in patients with evidence of hepatic dysfunction, patients >50 years of age, and those with serious underlying disease. In these patients, hepatic events may be severe, and in extremely rare circumstances, deaths have been reported (see section 4.8).

Dosage should be adjusted in renal impairment (see section 4.2).

Special caution is essential in the newborn because of the risk of hyperbilirubinemia. Studies have shown that, at high dose following parenteral administration, flucloxacillin can displace bilirubin from plasma protein binding sites, and may therefore predispose to kernicterus in a jaundiced baby. In addition, special caution is essential in the newborn because of the potential for high serum levels of flucloxacillin due to a reduced rate of renal excretion.

During prolonged treatments (e.g. osteomyelitis, endocarditis), regular monitoring of hepatic and renal functions is recommended.

Prolonged use may occasionally result in overgrowth of non-susceptible organisms.

Caution is advised when flucloxacillin is administered concomitantly with paracetamol due to the increased risk of high anion gap metabolic acidosis (HAGMA). Patients at high risk for HAGMA are in particular those with severe renal impairment, sepsis or malnutrition especially if the maximum daily doses of paracetamol are used.

After co-administration of flucloxacillin and paracetamol, a close monitoring is recommended in order to detect the appearance of acid-base disorders, namely HAGMA, including the search of urinary 5-oxoproline.

If flucloxacillin is continued after cessation of paracetamol, it is advisable to ensure that there are no signals of HAGMA, as there is a possibility of flucloxacillin maintaining the clinical picture of HAGMA (see section 4.5).

Hypokalaemia (potentially life threatening) can occur with the use of flucloxacillin, especially in high doses. Hypokalaemia caused by flucloxacillin can be resistant to potassium supplementation. Regular measurements of potassium levels are recommended during the therapy with higher doses of flucloxacillin. Attention for this risk is warranted also when combining flucloxacillin with hypokalaemia-inducing diuretics or when other risk factors for the development of hypokalaemia are present (e.g. malnutrition, renal tubule dysfunction).

This medicinal product contains 51 mg sodium per vial, equivalent to 2.55% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

4.5 Interaction with other medicinal products and other forms of interaction

Probenecid decreases the renal tubular secretion of flucloxacillin. Concurrent administration of probenecid delays the renal excretion of flucloxacillin.

Bacteriostatic drugs (e.g. chloramphenicol, erythromycin, sulphonamides and tetracyclines) may interfere with the bactericidal action of flucloxacillin.

Flucloxacillin can influence the outcome of the Guthrie-Test (false-positive). Blood samples should be taken before the administration of flucloxacillin.

Caution should be taken when flucloxacillin is used concomitantly with paracetamol as concurrent intake has been associated with high anion gap metabolic acidosis, especially in patients with risk factors. (see section 4.4).

Penicillins may produce false-positive results with the direct antiglobulin (Coombs') test, falsely high urinary glucose results with the copper sulphate test and falsely high urinary protein results, but glucose enzymatic tests and bromophenol blue tests are not affected.

Flucloxacillin (CYP450 inducer) has been reported to significantly decrease plasma voriconazole concentrations. If concomitant administration of flucloxacillin with voriconazole cannot be avoided, monitor for potential loss of voriconazole effectiveness (e.g. by therapeutic drug monitoring); increasing the dose of voriconazole may be needed.

4.6 Fertility, pregnancy and lactation

Pregnancy

Animal studies with flucloxacillin have shown no teratogenic effects. Limited information is available on the use of flucloxacillin in human pregnancy. Flucloxacillin should only be used in pregnancy when the potential benefits outweigh the potential risks associated with treatment.

Breastfeeding

During lactation, trace quantities of penicillins can be detected in breast milk. Flucloxacillin may be administered during the period of lactation. With the exception of risk of sensitisation there are no other detrimental effects for the breast fed infant.

4.7 Effects on ability to drive and use machines

None known.

4.8 Undesirable effects

The following convention has been utilised for the classification of undesirable effects:

Very common ($>1/10$), common ($>1/100$ and $<1/10$), uncommon ($>1/1,000$ and $<1/100$), rare ($>1/10,000$ and $<1/1,000$), very rare ($<1/10,000$), not known (cannot be estimated from the available data).

Unless otherwise stated, the frequency of the adverse events has been derived from more than 30 years of post-marketing reports.

Blood and lymphatic system disorders

Very rare: Neutropenia (including agranulocytosis) and thrombocytopenia. These are reversible when treatment is discontinued. Eosinophilia, haemolytic anaemia.

Immune system disorders

Very rare: Anaphylactic shock (exceptional with oral administration) (see section 4.4), angioneurotic oedema. If any hypersensitivity reaction occurs, the treatment should be discontinued. (See also Skin and subcutaneous tissue disorders).

Metabolism and nutrition disorders

Very rare: Cases of high anion gap metabolic acidosis, when flucloxacillin is used concomitantly with paracetamol, generally in the presence of risk factors (see section 4.4).

Not known: Hypokalaemia

Nervous system disorders

Very rare: In patients suffering from renal failure, neurological disorders with convulsions are possible with the i.v. injection of high doses.

Gastrointestinal disorders

**Common:* Minor gastrointestinal disturbances.

Very rare: Pseudomembranous colitis.

If pseudomembranous colitis develops, flucloxacillin treatment should be discontinued and appropriate therapy, e.g. oral vancomycin should be initiated.

Hepatobiliary disorders

Very rare: Hepatitis and cholestatic jaundice (see Section 4.4).

Changes in liver function laboratory test results (reversible when treatment is discontinued).

Hepatitis and cholestatic jaundice may be delayed for up to two months post-treatment. In some cases the course has been protracted and lasted for several months. Hepatic events may be severe, and in very rare circumstances, deaths have been reported. Most reports of deaths have been in patients >50 years of age and in patients with serious underlying disease. There is evidence that the risk of flucloxacillin induced liver injury is increased in subjects carrying the HLA-B*5701 allele. Despite this strong association, only 1 in 500-1,000 carriers will develop liver injury. Consequently, the positive predictive value of testing the HLA-B*5701 allele for liver injury is very low (0.12%) and routine screening for this allele is not recommended.

Skin and subcutaneous tissue disorders

**Uncommon:* Rash, urticaria and purpura.

Very rare: Erythema multiforme, Stevens-Johnson syndrome, and toxic epidermal necrolysis.

(See also Immune system disorders).

Not known: AGEP – acute generalized exanthematous pustulosis (see section 4.4).

Musculoskeletal and connective tissue disorders

Very rare: Arthralgia and myalgia sometimes develop more than 48 hours after the start of the treatment.

Renal and urinary disorders

Very rare: Interstitial nephritis

This is reversible when treatment is discontinued.

General disorders and administration site conditions

Very rare: Fever sometimes develops more than 48 hours after the start of the treatment.

*The incidence of these adverse events (AEs) was derived from clinical studies involving a total of approximately 929 adult and paediatric patients taking flucloxacillin.

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 HPRA Pharmacovigilance Website: www.hpra.ie.

4.9 Overdose

Gastrointestinal effects such as nausea, vomiting and diarrhoea may be evident and should be treated symptomatically.

Flucloxacillin is not removed from the circulation by haemodialysis.

5 PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Beta-lactamase resistant penicillins, ATC code: J01CF05.

Flucloxacillin is a semisynthetic penicillin (beta-lactam antibiotic; isoxazolympenicillin) with a narrow spectrum of activity primarily against Gram-positive organisms, including β -lactamase-producing strains.

There is evidence that the risk of flucloxacillin induced liver injury is increased in subjects carrying the HLA-B*5701 allele. Despite this strong association, only 1 in 500-1,000 carriers will develop liver injury. Consequently, the positive predictive value of testing the HLA-B*5701 allele for liver injury is very low (0.12%) and routine screening for this allele is not recommended.

Mechanism of action

Flucloxacillin inhibits one or more enzymes (often referred to as penicillin-binding proteins, PBPs) in the biosynthetic pathway of bacterial peptidoglycan, which is an integral structural component of the bacterial cell wall. Inhibition of peptidoglycan synthesis leads to weakening of the cell wall, which is usually followed by cell lysis and death.

PK/PD relationship

The time above the minimum inhibitory concentration ($T > MIC$) is considered to be the major determinant of efficacy for flucloxacillin.

Mechanism of resistance

Resistance to isoxazolympenicillins (so-called methicillin-resistance) is caused by the bacteria producing an altered penicillin binding protein. Cross resistance may occur in the beta-lactam group with other penicillins and cephalosporins. Methicillin-resistant staphylococci generally have low susceptibility for all beta-lactam antibiotics.

Antimicrobial activity

Flucloxacillin is active against both β -lactamase-positive and -negative strains of *Staphylococcus aureus* and other aerobic Gram-positive cocci, with the exception of *Enterococcus faecalis*. Gram-positive anaerobes are generally susceptible (MIC 0.25-2 mg/l) but Gram-negative bacilli or anaerobes are moderately to fully resistant. Enterobacteria are fully resistant to flucloxacillin as well as methicillin-resistant staphylococci.

Strains of the following organisms are generally sensitive to the bactericidal action of flucloxacillin *in vitro*.

The minimal inhibitory concentrations (MIC) of flucloxacillin are quoted below:

Micro-organisms	MIC (mg/l)
<i>Staphylococcus aureus</i>	0.1 to 0.25
<i>Staphylococcus aureus</i> (beta-lactamase+)	0.25 to 0.5

<i>Streptococcus pneumoniae</i>	0.25
<i>Streptococcus pyogenes</i> (Group A beta-haemolytic) [†]	0.1
<i>Streptococcus viridians</i> group	0.5
<i>Clostridium tetani</i>	0.25
<i>Clostridium welchii</i>	0.25
<i>Neisseria meningitidis</i>	0.1
<i>Neisseria gonorrhoeae</i>	0.1
<i>Neisseria gonorrhoeae</i> (beta-lactamase +)	2.5
[†] The Group A beta-haemolytic streptococci are less sensitive to the isoxazolyl penicillins than to penicillin G or penicillin V.	

5.2 Pharmacokinetic properties

Absorption

The peak serum levels of flucloxacillin reached after 1h are as follows:

- After 500 mg by the i.m. route: approximately 16.5 mg/l

Distribution

Protein binding: the serum protein binding rate is 95%.

Flucloxacillin diffuses well into most tissues.

Crossing the meningeal barrier: flucloxacillin diffuses in only small proportion into the cerebrospinal fluid of subjects whose meninges are not inflamed.

Crossing into mother's milk: flucloxacillin is excreted in small quantities in mother milk.

Biotransformation

In normal subjects approximately 10% of the flucloxacillin administered is metabolised to penicilloic acid. The elimination half life of flucloxacillin is on the order of 53min.

Elimination

Excretion occurs mainly through the kidney. Sixty five per cent of the dose administered orally is recovered in unaltered active form in the urine within 8h. A small portion of the dose administered is excreted in the bile. The excretion of flucloxacillin is slowed in cases of renal failure.

Neonates and infants

The clearance of flucloxacillin is considerably slower in neonates compared with adults and a mean elimination half life of approximately four and a half hours has been reported in neonates. Special care should be taken during administration of flucloxacillin to the newborn (see section 4.4).

Younger infants (<6 months) achieve higher plasma concentrations of flucloxacillin than older children when given the same dose.

Patients with renal impairment

In patients with severe renal impairment the elimination half life of flucloxacillin increases to values of between 135-173 min. Modified dosage is required if renal impairment is severe, with creatinine clearance <10 ml/min (see section 4.2).

Patients with hepatic impairment

Hepatic disease is thought unlikely to influence the pharmacokinetics of flucloxacillin as the antibiotic is cleared primarily via the renal route.

5.3 Preclinical safety data

There is no preclinical data of relevance to the prescriber, which are additional to those already included in other sections of the SmPC.

6 PHARMACEUTICAL PARTICULARS

6.1 List of excipients

None.

6.2 Incompatibilities

Flucloxacillin should not be mixed with blood products or other proteinaceous fluids (e.g. protein hydrolysates) or with intravenous lipid emulsions.

If flucloxacillin is prescribed concurrently with an aminoglycoside, the two antibiotics should not be mixed in the same syringe, intravenous fluid container or giving set; precipitation may occur.

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

6.3 Shelf life

Unopened product

3 years.

Reconstituted solution

Reconstitution with Water for injection, Sodium Chloride 0.9 %, Dextrose 5 %, or Sodium Chloride 0.18 % with glucose 4 %:

Chemical and physical in-use stability has been demonstrated for 30 minutes at 20 °C-25 °C. From a microbiological point of view, the product should be used immediately. If not used immediately, in-use storage times and conditions prior to use are the responsibility of the user and would normally not be longer than 24 hours at 2 °C-8 °C. Reconstitution of the injection and preparation of the infusion solutions must be carried out under the appropriate aseptic conditions if these extended storage periods are required.

Reconstitution with Hartmann's solution:

Use immediately after reconstitution.

6.4 Special precautions for storage

Unopened product

This medicinal product does not require any special storage conditions.

Reconstituted solution

For storage conditions after reconstitution, see section 6.3.

6.5 Nature and contents of container

Type III transparent, clear, glass vials, 20 ml, 20 mm closed with a 20 mm chlorobutyl rubber stoppers and an aluminium sealing ring with a flip-off cap. The vials are placed into carton box.

Packs of 1 vial and 10 vials.

Not all pack sizes may be marketed.

6.6 Special precautions for disposal and other handling

For single use only. Discard any unused solution.

Floxapen 1000 mg powder for solution for injection/infusion may be added to the following infusion fluids:

water for injections,
sodium chloride 0.9%,
dextrose 5%,

sodium chloride 0.18% with glucose 4%

Compound Sodium Lactate Intravenous Infusion BP (Ringer-Lactate solution; Hartmann's Solution).

Intramuscular: Add 3.0 ml Water for Injections to 1 g vial contents. Add 4.0 ml water for injections to 2 g vial contents.

Intravenous: Dissolve 1 g in 20 ml water for injection or 2 g in 40 ml water for injections. Administer by slow intravenous injection. Flucloxacillin may also be added slowly to infusion fluids or injected, suitably diluted, into the drip tube.

Appearance of the solution

Clear colourless or pale yellow particle free solution.

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

7 MARKETING AUTHORISATION HOLDER

Teva B.V.
Swensweg 5
2031GA Haarlem
Netherlands

8 MARKETING AUTHORISATION NUMBER

PA1986/111/003

9 DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION

Date of first authorisation: 3rd August 2012

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10 DATE OF REVISION OF THE TEXT

June 2023