

Summary of Product Characteristics

1 NAME OF THE MEDICINAL PRODUCT

Rocephin 1 g powder and solvent for IM injection only

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each vial of powder contains 1 g ceftriaxone as ceftriaxone sodium.

Each 1 ml of solvent contains 10 mg of lidocaine hydrochloride, corresponding to 35 mg of lidocaine hydrochloride per 3.5 ml.

For the full list of excipients, see section 6.1.

3 PHARMACEUTICAL FORM

Powder and solvent for solution for IM injection.

Powder: White to yellowish-orange crystalline powder.

Solvent: A clear colourless solution.

4 CLINICAL PARTICULARS

4.1 Therapeutic indications

Rocephin is indicated for the treatment of the following infections in adults and children including term neonates (from birth):

Bacterial Meningitis
Community acquired pneumonia
Hospital acquired pneumonia
Acute otitis media
Intra-abdominal infections
Complicated urinary tract infections (including pyelonephritis)
Infections of bones and joints
Complicated skin and soft tissue infections
Gonorrhoea
Syphilis
Bacterial endocarditis

Rocephin may be used:

For treatment of acute exacerbations of chronic obstructive pulmonary disease in adults

For treatment of disseminated Lyme borreliosis (early (stage II) and late (stage III)) in adults and children including neonates from 15 days of age

For Pre-operative prophylaxis of surgical site infections

In the management of neutropenic patients with fever that is suspected to be due to a bacterial infection

In the treatment of patients with bacteraemia that occurs in association with, or is suspected to be associated with, any of the infections listed above

Rocephin should be co-administered with other antibacterial agents whenever the possible range of causative bacteria would not fall within its spectrum (see section 4.4).

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

4.2 Posology and method of administration

Posology

The dose depends on the severity, susceptibility, site and type of infection and on the age and hepato-renal function of the patient.

The doses recommended in the tables below are the generally recommended doses in these indications. In particularly severe cases, doses at the higher end of the recommended range should be considered.

Adults and children over 12 years of age ($\geq 50\text{kg}$)

Ceftriaxone Dosage*	Treatment frequency**	Indications
1-2 g	Once daily	Community acquired pneumonia
		Acute exacerbations of chronic obstructive pulmonary disease
		Intra-abdominal infections
		Complicated urinary tract infections (including pyelonephritis)
2 g	Once daily	Hospital acquired pneumonia
		Complicated skin and soft tissue infections
		Infections of bones and joints
2-4 g	Once daily	Management of neutropenic patients with fever that is suspected to be due to a bacterial infection
		Bacterial endocarditis
		Bacterial meningitis

* In documented bacteraemia, the higher end of the recommended dose range should be considered.

** Twice daily (12 hourly) administration may be considered where doses greater than 2 g daily are administered.

Indications for adults and children over 12 years of age ($\geq 50\text{ kg}$) that require specific dosage schedules:

Acute otitis media

A single intramuscular dose of Rocephin 1-2 g can be given.

Limited data suggest that in cases where the patient is severely ill or previous therapy has failed, Rocephin may be effective when given as an intramuscular dose of 1-2 g daily for 3 days.

Pre-operative prophylaxis of surgical site infections

2 g as a single pre-operative dose.

Gonorrhoea

500 mg as a single intramuscular dose.

Syphilis

The generally recommended doses are 500 mg-1 g once daily increased to 2 g once daily for neurosyphilis for 10-14 days.

The dose recommendations in syphilis, including neurosyphilis, are based on limited data. National or local guidance should be taken into consideration.

Disseminated Lyme borreliosis (early [Stage II] and late [Stage III])

2 g once daily for 14-21 days. The recommended treatment durations vary and national or local guidelines should be taken into consideration.

Paediatric population

Neonates, infants and children 15 days to 12 years of age ($< 50\text{ kg}$)

For children with bodyweight of 50 kg or more, the usual adult dosage should be given. The maximum single dose of lidocaine in children should not exceed 5 mg/kg bodyweight. For obese children, the maximum dose should be calculated based on ideal bodyweight for their gender and age.

Ceftriaxone dosage*	Treatment frequency**	Indications
50-80 mg/kg	Once daily	Intra-abdominal infections
		Complicated urinary tract infections (including pyelonephritis)
		Community acquired pneumonia
		Hospital acquired pneumonia
50-100 mg/kg (Max 4 g)	Once daily	Complicated skin and soft tissue infections
		Infections of bones and joints

		Management of neutropenic patients with fever that is suspected to be due to a bacterial infection
80-100 mg/kg (max 4 g)	Once daily	Bacterial meningitis
100 mg/kg (max 4 g)	Once daily	Bacterial endocarditis

* In documented bacteraemia, the higher end of the recommended dose range should be considered.

** Twice daily (12 hourly) administration may be considered where doses greater than 2 g daily are administered.

Indications for neonates, infants and children 15 days to 12 years (< 50 kg) that require specific dosage schedules:

Acute otitis media

For initial treatment of acute otitis media, a single intramuscular dose of Rocephin 50 mg/kg can be given. Limited data suggest that in cases where the child is severely ill or initial therapy has failed, Rocephin may be effective when given as an intramuscular dose of 50 mg/kg daily for 3 days.

Pre-operative prophylaxis of surgical site infections

50-80 mg/kg as a single pre-operative dose.

Syphilis

The generally recommended doses are 75-100 mg/kg (max 4 g) once daily for 10-14 days. The dose recommendations in syphilis, including neurosyphilis, are based on very limited data. National or local guidance should be taken into consideration.

Disseminated Lyme borreliosis (early [Stage II] and late [Stage III])

50-80 mg/kg once daily for 14-21 days. The recommended treatment durations vary and national or local guidelines should be taken into consideration.

Neonates 0-14 days

Rocephin is contraindicated in premature neonates up to a postmenstrual age of 41 weeks (gestational age + chronological age).

Ceftriaxone dosage*	Treatment frequency	Indications
20-50 mg/kg	Once daily	Intra-abdominal infections
		Complicated skin and soft tissue infections
		Complicated urinary tract infections (including pyelonephritis)
		Community acquired pneumonia
		Hospital acquired pneumonia
50 mg/kg	Once daily	Infections of bones and joints
		Management of neutropenic patients with fever that is suspected to be due to a bacterial infection
		Bacterial meningitis
		Bacterial endocarditis

* In documented bacteraemia, the higher end of the recommended dose range should be considered.

A maximum daily dose of 50 mg/kg should not be exceeded.

Indications for neonates 0-14 days that require specific dosage schedules:

Acute otitis media

For initial treatment of acute otitis media, a single intramuscular dose of Rocephin 50 mg/kg can be given.

Pre-operative prophylaxis of surgical site infections

20-50 mg/kg as a single pre-operative dose.

Syphilis

The generally recommended dose is 50 mg/kg once daily for 10-14 days. The dose recommendations in syphilis, including neurosyphilis, are based on very limited data. National or local guidance should be taken into consideration.

Duration of therapy

The duration of therapy varies according to the course of the disease. As with antibiotic therapy in general, administration of ceftriaxone should be continued for 48 - 72 hours after the patient has become afebrile or evidence of bacterial eradication has been achieved.

Older people

The dosages recommended for adults require no modification in older people provided that renal and hepatic function is satisfactory.

Patients with hepatic impairment

Available data do not indicate the need for dose adjustment in mild or moderate liver function impairment provided renal function is not impaired.

There are no study data in patients with severe hepatic impairment (see section 5.2).

Patients with renal impairment

In patients with impaired renal function, there is no need to reduce the dosage of ceftriaxone provided hepatic function is not impaired. Only in cases of preterminal renal failure (creatinine clearance < 10 ml/min) should the ceftriaxone dosage not exceed 2 g daily.

In patients undergoing dialysis no additional supplementary dosing is required following the dialysis. Ceftriaxone is not removed by peritoneal- or haemodialysis. Close clinical monitoring for safety and efficacy is advised.

Patients with severe hepatic and renal impairment

In patients with both severe renal and hepatic dysfunction, close clinical monitoring for safety and efficacy is advised.

Method of administration

Rocephin can be administered by deep intramuscular injection. Intramuscular injections should be injected well within the bulk of a relatively large muscle and not more than 1 g should be injected at one site.

As the solvent used is lidocaine, the resulting solution should never be administered intravenously (see section 4.3). Accidental intravenous injection should be checked for by aspiration of the syringe before injection.

Ceftriaxone is contraindicated in neonates (\leq 28 days) if they require (or are expected to require) treatment with calcium-containing intravenous solutions, including continuous calcium-containing infusions such as parenteral nutrition, because of the risk of precipitation of ceftriaxone-calcium (see section 4.3).

For pre-operative prophylaxis of surgical site infections, ceftriaxone should be administered 30-90 minutes prior to surgery.

For instructions on reconstitution of the medicinal product before administration, see section 6.6.

4.3 Contraindications

Ceftriaxone

Hypersensitivity to ceftriaxone, or to any other cephalosporin.

History of severe hypersensitivity (e.g. anaphylactic reaction) to any other type of beta-lactam antibacterial agent (penicillins, monobactams and carbapenems).

Ceftriaxone is contraindicated in:

Premature neonates up to a postmenstrual age of 41 weeks (gestational age + chronological age)*

Full-term neonates (up to 28 days of age):

- with hyperbilirubinaemia, jaundice, or who are hypoalbuminaemic or acidotic because these are conditions in which bilirubin binding is likely to be impaired*

- if they require (or are expected to require) intravenous calcium treatment, or calcium-containing infusions due to the risk of precipitation of aceftriaxone-calcium salt (see sections 4.4, 4.8 and 6.2).

* *In vitro* studies have shown that ceftriaxone can displace bilirubin from its serum albumin binding sites leading to a possible risk of bilirubin encephalopathy in these patients.

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Lidocaine

Contraindications to lidocaine must be excluded before intramuscular injection of ceftriaxone when lidocaine solution is used as a solvent (see section 4.4).

- Known hypersensitivity to lidocaine or other amide anaesthetics.
- Complete heart block
- Hypovolaemia

Ceftriaxone solutions containing lidocaine should never be administered intravenously.

4.4 Special warnings and precautions for use

Ceftriaxone

Hypersensitivity reactions

As with all beta-lactam antibacterial agents, serious and occasionally fatal hypersensitivity reactions have been reported (see section 4.8). Hypersensitivity reactions can also progress to Kounis syndrome, a serious allergic reaction that can result in myocardial infarction (see section 4.8). In case of severe hypersensitivity reactions, treatment with ceftriaxone must be discontinued immediately and adequate emergency measures must be initiated. Before beginning treatment, it should be established whether the patient has a history of severe hypersensitivity reactions to ceftriaxone, to other cephalosporins or to any other type of beta-lactam agent. Caution should be used if ceftriaxone is given to patients with a history of non-severe hypersensitivity to other beta-lactam agents.

Severe cutaneous adverse reactions (Stevens Johnson syndrome or Lyell's syndrome/toxic epidermal necrolysis and drug reaction with eosinophilia and systemic symptoms (DRESS)) which can be life-threatening or fatal have been reported in association of ceftriaxone treatment; however, the frequency of these events is not known (see section 4.8).

Interaction with calcium containing products

Cases of fatal reactions with calcium-ceftriaxone precipitates in lungs and kidneys in premature and full-term neonates aged less than 1 month have been described. At least one of them had received ceftriaxone and calcium at different times and through different intravenous lines. In the available scientific data, there are no reports of confirmed intravascular precipitations in patients, other than neonates, treated with ceftriaxone and calcium-containing solutions or any other calcium-containing products. *In vitro* studies demonstrated that neonates have an increased risk of precipitation of ceftriaxone-calcium compared to other age groups.

In patients of any age ceftriaxone must not be mixed or administered simultaneously with any calcium-containing intravenous solutions, even via different infusion lines or at different infusion sites. However, in patients older than 28 days of age ceftriaxone and calcium-containing solutions may be administered sequentially one after another if infusion lines at different sites are used or if the infusion lines are replaced or thoroughly flushed between infusions with physiological salt-solution to avoid precipitation. In patients requiring continuous infusion with calcium-containing total parenteral nutrition (TPN) solutions, healthcare professionals may wish to consider the use of alternative antibacterial treatments which do not carry a similar risk of precipitation. If the use of ceftriaxone is considered necessary in patients requiring continuous nutrition, TPN solutions and ceftriaxone can be administered simultaneously, albeit via different infusion lines at different sites. Alternatively, infusion of TPN solution could be stopped for the period of ceftriaxone infusion and the infusion lines flushed between solutions (see sections 4.3, 4.8, 5.2 and 6.2).

Paediatric population

Safety and effectiveness of Rocephin in neonates, infants and children have been established for the dosages described under Posology and Method of Administration (see section 4.2). Studies have shown that ceftriaxone, like some other cephalosporins, can displace bilirubin from serum albumin.

Rocephin is contraindicated in premature and full-term neonates at risk of developing bilirubin encephalopathy (see section 4.3).

Immune mediated haemolytic anaemia

An immune mediated haemolytic anaemia has been observed in patients receiving cephalosporin class antibacterials including Rocephin (see section 4.8). Severe cases of haemolytic anaemia, including fatalities, have been reported during Rocephin treatment in both adults and children.

If a patient develops anaemia while on ceftriaxone, the diagnosis of a cephalosporin-associated anaemia should be considered and ceftriaxone discontinued until the aetiology is determined.

Long term treatment

During prolonged treatment complete blood count should be performed at regular intervals.

Colitis/Overgrowth of non-susceptible microorganisms

Antibacterial agent-associated colitis and pseudo-membranous colitis have been reported with nearly all antibacterial agents, including ceftriaxone, and may range in severity from mild to life-threatening. Therefore, it is important to consider this diagnosis in patients who present with diarrhoea during or subsequent to the administration of ceftriaxone (see section 4.8). Discontinuation of therapy with ceftriaxone and the administration of specific treatment for *Clostridium difficile* should be considered. Medicinal products that inhibit peristalsis should not be given.

Superinfections with non-susceptible micro-organisms may occur as with other antibacterial agents.

Severe renal and hepatic insufficiency

In severe renal and hepatic insufficiency, close clinical monitoring for safety and efficacy is advised (see section 4.2).

Interference with serological testing

Interference with Coombs tests may occur, as Rocephin may lead to false-positive test results. Rocephin can also lead to false-positive test results for galactosaemia (see section 4.8).

Non-enzymatic methods for the glucose determination in urine may give false-positive results. Urine glucose determination during therapy with Rocephin should be done enzymatically (see section 4.8).

The presence of ceftriaxone may falsely lower estimated blood glucose values obtained with some blood glucose monitoring systems. Please refer to instructions for use for each system. Alternative testing methods should be used if necessary.

Sodium

This medicinal product contains 85.4 mg sodium per 1g vial, equivalent to 4.3% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

Antibacterial spectrum

Ceftriaxone has a limited spectrum of antibacterial activity and may not be suitable for use as a single agent for the treatment of some types of infections unless the pathogen has already been confirmed (see section 4.2). In polymicrobial infections, where suspected pathogens include organisms resistant to ceftriaxone, administration of an additional antibiotic should be considered.

Biliary lithiasis

When shadows are observed on sonograms, consideration should be given to the possibility of precipitates of calcium ceftriaxone. Shadows, which have been mistaken for gallstones, have been detected on sonograms of the gallbladder and have been observed more frequently at ceftriaxone doses of 1 g per day and above. Caution should be particularly considered in the paediatric population. Such precipitates disappear after discontinuation of ceftriaxone therapy. Rarely precipitates of calcium ceftriaxone have been associated with symptoms. In symptomatic cases, conservative nonsurgical management is

recommended and discontinuation of ceftriaxone treatment should be considered by the physician based on specific benefit risk assessment (see section 4.8).

Biliary stasis

Cases of pancreatitis, possibly of biliary obstruction aetiology, have been reported in patients treated with Rocephin (see section 4.8). Most patients presented with risk factors for biliary stasis and biliary sludge e.g. preceding major therapy, severe illness and total parenteral nutrition. A trigger or cofactor of Rocephin-related biliary precipitation cannot be ruled out.

Renal lithiasis

Cases of renal lithiasis have been reported, which is reversible upon discontinuation of ceftriaxone (see section 4.8). In symptomatic cases, sonography should be performed. Use in patients with history of renal lithiasis or with hypercalciuria should be considered by the physician based on specific benefit risk assessment.

Jarisch-Herxheimer reaction (JHR)

Some patients with spirochete infections may experience a Jarisch-Herxheimer reaction (JHR) shortly after ceftriaxone treatment is started. JHR is usually a self – limiting condition or can be managed by symptomatic treatment. The antibiotic treatment should not be discontinued if such reaction occurs.

Encephalopathy

Encephalopathy has been reported with the use of ceftriaxone (see section 4.8), particularly in elderly patients with severe renal impairment (see section 4.2) or central nervous system disorders. If ceftriaxone-associated encephalopathy is suspected (e.g. decreased level of consciousness, altered mental state, myoclonus, convulsions), discontinuation of ceftriaxone should be considered.

Lidocaine

Lidocaine (contained in the solvent for the intramuscular injection) should be used with caution in patients with myasthenia gravis, epilepsy, impaired cardiac conduction, congestive heart failure, bradycardia or respiratory depression. Lidocaine should also be used with caution in cases where agents are known to interact with lidocaine either to increase its availability or additive effects e.g. phenytoin or prolong its elimination e.g. hepatic or renal insufficiency where the metabolites of lidocaine may accumulate.

Intramuscular lidocaine may increase creatinine phosphokinase concentrations which can interfere with the diagnosis of acute myocardial infarction. Lidocaine has been shown to be porphyrinogenic in animals and should be avoided in persons suffering from porphyria.

In neonates, the optimum serum concentration of lidocaine required to avoid toxicity, such as convulsions and cardiac arrhythmias, in this age group is not known.

4.5 Interaction with other medicinal products and other forms of interaction

Ceftriaxone

Calcium-containing diluents, such as Ringer's solution or Hartmann's solution, should not be used to reconstitute Rocephin vials or to further dilute a reconstituted vial for intravenous administration because a precipitate can form. Precipitation of ceftriaxone-calcium can also occur when ceftriaxone is mixed with calcium-containing solutions in the same intravenous administration line. Ceftriaxone must not be administered simultaneously with calcium-containing intravenous solutions, including continuous calcium-containing infusions such as parenteral nutrition via a Y-site. However, in patients other than neonates, ceftriaxone and calcium-containing solutions may be administered sequentially of one another if the infusion lines are thoroughly flushed between infusions with a compatible fluid. *In vitro* studies using adult and neonatal plasma from umbilical cord blood demonstrated that neonates have an increased risk of precipitation of ceftriaxone-calcium (see sections 4.2, 4.3, 4.4, 4.8 and 6.2).

Concomitant use with oral anticoagulants may increase the anti-vitamin K effect and the risk of bleeding. It is recommended that the International Normalised Ratio (INR) is monitored frequently and the posology of the anti-vitamin K drug adjusted accordingly, both during and after treatment with ceftriaxone (see section 4.8).

There is conflicting evidence regarding a potential increase in renal toxicity of aminoglycosides when used with cephalosporins. The recommended monitoring of aminoglycoside levels (and renal function) in clinical practice should be closely adhered to in such cases.

In an *in-vitro* study antagonistic effects have been observed with the combination of chloramphenicol and ceftriaxone. The clinical relevance of this finding is unknown.

There have been no reports of an interaction between ceftriaxone and oral calcium-containing products or interaction between intramuscular ceftriaxone and calcium-containing products (intravenous or oral).

In patients treated with ceftriaxone, the Coombs' test may lead to false-positive test results.

Ceftriaxone, like other antibiotics, may result in false-positive tests for galactosaemia.

Likewise, non-enzymatic methods for glucose determination in urine may yield false-positive results. For this reason, glucose level determination in urine during therapy with ceftriaxone should be carried out enzymatically.

No impairment of renal function has been observed after concurrent administration of large doses of ceftriaxone and potent diuretics (e.g. furosemide).

Simultaneous administration of probenecid does not reduce the elimination of ceftriaxone.

Lidocaine

Pharmacokinetic interactions: lidocaine is a substrate for the CYP450 enzymes CYP1A2 and CYP3A4. lidocaine metabolism can therefore be inhibited by concomitant administration of CYP inhibitors (e.g. clarithromycin, erythromycin, cimetidine) and enhanced by concomitant administration of enzyme inducers (e.g. barbiturates, carbamazepine, phenytoin, primidone, rifampicin).

Pharmacodynamic interactions: Systemic toxic effects may be additive during concomitant use of active substances that are structural analogues of amide-type local anaesthetics (e.g. antiarrhythmic drugs like mexiletine or tocainide). The i.m. injection of Rocephin (with a solvent containing lidocaine) should therefore be administered with particular caution to patients who are undergoing treatment with such medicinal products. The effects of muscle relaxants can be enhanced by lidocaine. Please refer to the summary of product characteristics for the medicinal products being administered concomitantly.

4.6 Fertility, pregnancy and lactation

Ceftriaxone

Pregnancy

Ceftriaxone crosses the placental barrier. There are limited amounts of data from the use of ceftriaxone in pregnant women. Animal studies do not indicate direct or indirect harmful effects with respect to embryonal/foetal, perinatal and postnatal development (see section 5.3). Ceftriaxone should only be administered during pregnancy and in particular in the first trimester of pregnancy if the benefit outweighs the risk.

Breastfeeding

Ceftriaxone is excreted into human milk in low concentrations but at therapeutic doses of ceftriaxone no effects on the breastfed infants are anticipated. However, a risk of diarrhoea and fungal infection of the mucous membranes cannot be excluded. The possibility of sensitisation should be taken into account. A decision must be made whether to discontinue breast-feeding or to discontinue/abstain from ceftriaxone therapy, taking into account the benefit of breast feeding for the child and the benefit of therapy for the woman.

Fertility

Reproductive studies have shown no evidence of adverse effects on male or female fertility.

Lidocaine

Pregnancy

Although animal studies have revealed no evidence of harm to the foetus, lidocaine should not be administered during early pregnancy unless the benefits are considered to outweigh the risks.

Breastfeeding

Small amounts of lidocaine are secreted into breast milk and the possibility of an allergic reaction in the infant, albeit remote, should be borne in mind when using lidocaine in nursing mothers.

Fertility

There is no data available on fertility with the use of lidocaine.

4.7 Effects on ability to drive and use machines

During treatment with ceftriaxone, undesirable effects may occur (e.g. dizziness), which may influence the ability to drive and use machines (see section 4.8). Patients should be cautious when driving or operating machinery.

4.8 Undesirable effectsCeftriaxone

The most frequently reported adverse reactions for ceftriaxone are eosinophilia, leucopenia, thrombocytopenia, diarrhoea, rash, and hepatic enzymes increased.

Data to determine the frequency of ceftriaxone ADRs was derived from clinical trials.

The following convention has been used for the classification of frequency:

Very common ($\geq 1/10$)

Common ($\geq 1/100 - < 1/10$)

Uncommon ($\geq 1/1000 - < 1/100$)

Rare ($\geq 1/10000 - < 1/1000$)

Not known (cannot be estimated from the available data)

System Organ Class	Common	Uncommon	Rare	Not Known^a
Infections and infestations		Genital fungal infection	Pseudo-membranous colitis ^b	Superinfection ^b
Blood and lymphatic system disorders	Eosinophilia Leucopenia Thrombocytopenia	Granulocytopenia Anaemia Coagulopathy		Haemolytic anaemia ^b Agranulocytosis
Immune system disorders				Anaphylactic shock Anaphylactic reaction Anaphylactoid reaction Hypersensitivity ^b Jarisch-Herxheimer reaction ^b
Nervous system disorders		Headache Dizziness	Encephalopathy	Convulsion
Ear and labyrinth disorders				Vertigo
Cardiac disorders				Kounis syndrome ^b
Respiratory, thoracic and mediastinal disorders			Bronchospasm	
Gastrointestinal disorders	Diarrhoea ^b Loose stools	Nausea Vomiting		Pancreatitis ^b Stomatitis Glossitis

Hepatobiliary disorders	Hepatic enzyme increased			Gall bladder precipitation ^b Kernicterus Hepatitis ^c Hepatitis cholestatic ^{b,c}
Skin and subcutaneous tissue disorders	Rash	Pruritus	Urticaria	Stevens Johnson Syndrome ^b Toxic epidermal necrolysis ^b Erythema multiforme Acute generalised exanthematous pustulosis Drug reaction with eosinophilia and systemic symptoms (DRESS) ^b
Renal and urinary disorders			Haematuria Glycosuria	Oliguria Renal precipitation (reversible)
General disorders and administration site conditions		Phlebitis Injection site reactions Pyrexia	Oedema Chills	
Investigations		Blood creatinine increased		Coombs test false positive ^b Galactosaemia test false positive ^b Non enzymatic methods for glucose determination false positive ^b

^a Based on post-marketing reports. Since these reactions are reported voluntarily from a population of uncertain size, it is not possible to reliably estimate their frequency which is therefore categorised as not known.

^b See section 4.4

^c Usually reversible upon discontinuation of ceftriaxone

Description of selected adverse reactions

Infections and infestations

Reports of diarrhoea following the use of ceftriaxone may be associated with *Clostridium difficile*. Appropriate fluid and electrolyte management should be instituted (see section 4.4).

Ceftriaxone-calcium salt precipitation

Rarely, severe, and in some cases, fatal, adverse reactions have been reported in pre-term and full-term neonates (aged < 28 days) who had been treated with intravenous ceftriaxone and calcium. Precipitations of ceftriaxone-calcium salt have been observed in lung and kidneys post-mortem. The high risk of precipitation in neonates is a result of their low blood volume and the longer half-life of ceftriaxone compared with adults (see sections 4.3, 4.4, and 5.2).

Cases of ceftriaxone precipitation in the urinary tract have been reported, mostly in children treated with high doses (e.g. ≥ 80 mg/kg/day or total doses exceeding 10 grams) and who have other risk factors (e.g. dehydration, confinement to bed). This event may be asymptomatic or symptomatic, and may lead to ureteric obstruction and postrenal acute renal failure, but is usually reversible upon discontinuation of ceftriaxone (see section 4.4).

Precipitation of ceftriaxone calcium salt in the gallbladder has been observed, primarily in patients treated with doses higher than the recommended standard dose. In children, prospective studies have shown a variable incidence of precipitation with intravenous application - above 30 % in some studies. The incidence appears to be lower with slow infusion (20 - 30 minutes). This effect is usually asymptomatic, but the precipitations have been accompanied by clinical symptoms such as pain, nausea and vomiting in rare cases. Symptomatic treatment is recommended in these cases. Precipitation is usually reversible upon discontinuation of ceftriaxone (see section 4.4).

Injection site reactions

IM injection is clinically painful. Other injection site reactions include injection site erythema, injection site extravasation, injection site swelling, injection site rash, injection site pruritus, injection site inflammation, injection site induration and injection site haematoma. Complications including injection site infection and injection site abscess have been reported rarely.

Lidocaine

The data presented below describe undesirable effects that have been observed with the use of lidocaine. There are no specific data for the combined use of ceftriaxone and lidocaine.

Adverse reactions to lidocaine are usually the result of raised plasma concentrations due to accidental intravascular injection, excessive dosage or rapid absorption from highly vascular areas, or may result from a hypersensitivity, idiosyncrasy or diminished tolerance on the part of the patient. Systemic toxicity mainly involves the central nervous system and/or the cardiovascular system.

System Organ Class	Common	Uncommon	Rare	Now known
Immune system disorders			Hypersensitivity reactions (allergic or anaphylactoid reactions and anaphylactic shock)	
Psychiatric disorders				Nervousness
Nervous system disorders				Dizziness or light-headedness Tremor Circumoral paresthesia Tongue numbness Drowsiness Convulsions Coma
Eye disorders				Blurred vision, Diplopia, Transient amaurosis
Ear and labyrinth disorders				Tinnitus, Hyperacusis
Cardiac disorders				Bradycardia, Myocardial depression Cardiac arrhythmia, Cardiac arrest
Vascular disorders				Hypotension, Circulatory collapse
Respiratory, thoracic and mediastinal disorders				Dyspnoea, Bronchospasm, Respiratory depression.
Gastrointestinal disorders				Nausea, Vomiting
Skin and subcutaneous tissue disorders				Rash, Urticarial, Oedema (including angioedema and face oedema)

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 HPRC Pharmacovigilance, Website: www.hpra.ie.

4.9 Overdose

Ceftriaxone

Symptoms

In overdose, the symptoms of nausea, vomiting and diarrhoea can occur.

Management

Ceftriaxone concentrations cannot be reduced by haemodialysis or peritoneal dialysis. There is no specific antidote. Treatment of overdose should be symptomatic.

Lidocaine

Symptoms

Overdose with lidocaine can manifest itself in a transient stimulation of the central nervous system with early symptoms: yawning, restlessness, dizziness, nausea, vomiting, dysarthria, ataxia, hearing and visual disturbances. With moderate intoxication also twitching and convulsions can occur. This can be followed by unconsciousness, respiratory depression and coma. In very severe intoxication due to decreased myocardial contractility and delayed impulse conduction, hypotension and cardiovascular collapse can be expected to be followed by a complete heart block and cardiac arrest.

Management

Convulsions, hypotension and respiratory depression and cardiac events should be treated as necessary. Continual optimal oxygenation and ventilation and circulatory support as well as treatment of acidosis are of vital importance.

5 PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Antibacterials for systemic use, Third-generation cephalosporins, ATC code: J01DD04.

Mode of action

Ceftriaxone inhibits bacterial cell wall synthesis following attachment to penicillin-binding proteins (PBPs). This results in the interruption of cell wall (peptidoglycan) biosynthesis, which leads to bacterial cell lysis and death.

Resistance

Bacterial resistance to ceftriaxone may be due to one or more of the following mechanisms:

- hydrolysis by beta-lactamases, including extended-spectrum beta-lactamases (ESBLs), carbapenemases and Amp C enzymes that may be induced or stably derepressed in certain aerobic Gram-negative bacterial species.
- reduced affinity of penicillin-binding proteins for ceftriaxone.
- outer membrane impermeability in Gram-negative organisms.
- bacterial efflux pumps.

Susceptibility testing breakpoints

MIC (minimum inhibitory concentration) interpretive criteria for susceptibility testing have been established by the European Committee on Antimicrobial Susceptibility Testing (EUCAST) for ceftriaxone and are listed here:

https://www.ema.europa.eu/documents/other/minimum-inhibitory-concentration-mic-breakpoints_en.xlsx

Clinical efficacy against specific pathogens

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

Commonly susceptible speciesGram-positive aerobes

Staphylococcus aureus (methicillin-susceptible)^f
 Staphylococci coagulase-negative (methicillin-susceptible)^f
Streptococcus pyogenes (Group A)
Streptococcus agalactiae (Group B)
Streptococcus pneumoniae
 Viridans Group *Streptococci*

Gram-negative aerobes

Borrelia burgdorferi
Haemophilus influenzae
Haemophilus parainfluenzae
Moraxella catarrhalis
Neisseria gonorrhoea
Neisseria meningitidis
Proteus mirabilis
Providencia spp.
Treponema pallidum

Species for which acquired resistance may be a problemGram-positive aerobes

Staphylococcus epidermidis⁺
Staphylococcus haemolyticus⁺
Staphylococcus hominis⁺

Gram-negative aerobes

Citrobacter freundii
Enterobacter aerogenes
Enterobacter cloacae
Escherichia coli[%]
Klebsiella pneumoniae[%]
Klebsiella oxytoca[%]
Morganella morganii
Proteus vulgaris
Serratia marcescens

Anaerobes

Bacteroides spp.
Fusobacterium spp.
Peptostreptococcus spp.
Clostridium perfringens

Inherently resistant organismsGram-positive aerobes

Enterococcus spp.
Listeria monocytogenes

Gram-negative aerobes

Acinetobacter baumannii
Pseudomonas aeruginosa
Stenotrophomonas maltophilia

Anaerobes

Clostridium difficile

Others:

Chlamydia spp.
Chlamydophila spp.
Mycoplasma spp.
Legionella spp.
Ureaplasma urealyticum

£ All methicillin-resistant staphylococci are resistant to ceftriaxone.

+ Resistance rates >50% in at least one region

% ESBL producing strains are always resistant

5.2 Pharmacokinetic properties

The pharmacokinetic results presented below are based on single agent studies in which Rocephin or lidocaine were administered alone. Lidocaine has no effect on the pharmacokinetics of ceftriaxone following intramuscular administration of Rocephin.

CeftriaxoneAbsorption

Following intramuscular injection, mean peak plasma ceftriaxone levels are approximately half those observed after intravenous administration of an equivalent dose. The maximum plasma concentration after a single intramuscular dose of 1 g is about 81 mg/l and is reached in 2 - 3 hours after administration.

The area under the plasma concentration-time curve after intramuscular administration is equivalent to that after intravenous administration of an equivalent dose.

Distribution

The volume of distribution of ceftriaxone is 7 – 12 l. Concentrations well above the minimal inhibitory concentrations of most relevant pathogens are detectable in tissue including lung, heart, biliary tract/liver, tonsil, middle ear and nasal mucosa, bone, and in cerebrospinal, pleural, prostatic and synovial fluids. An 8 - 15 % increase in mean peak plasma concentration (C_{max}) is seen on repeated administration; steady state is reached in most cases within 48 - 72 hours depending on the route of administration.

Penetration into particular tissues

Ceftriaxone penetrates the meninges. Penetration is greatest when the meninges are inflamed. Mean peak ceftriaxone concentrations in CSF in patients with bacterial meningitis are reported to be up to 25 % of plasma levels compared to 2 % of plasma levels in patients with uninfamed meninges. Peak ceftriaxone concentrations in CSF are reached approximately 4-6 hours after intravenous injection. Ceftriaxone crosses the placental barrier and is excreted in the breast milk at low concentrations (see section 4.6).

Protein binding

Ceftriaxone is reversibly bound to albumin. Plasma protein binding is about 95 % at plasma concentrations below 100 mg/l. Binding is saturable and the bound portion decreases with rising concentration (up to 85 % at a plasma concentration of 300 mg/l).

Biotransformation

Ceftriaxone is not metabolised systemically; but is converted to inactive metabolites by the gut flora.

Elimination

Plasma clearance of total ceftriaxone (bound and unbound) is 10 - 22 ml/min. Renal clearance is 5 - 12 ml/min. 50 - 60 % of ceftriaxone is excreted unchanged in the urine, primarily by glomerular filtration, while 40 - 50 % is excreted unchanged in the bile. The elimination half-life of total ceftriaxone in adults is about 8 hours.

Patients with renal or hepatic impairment

In patients with renal or hepatic dysfunction, the pharmacokinetics of ceftriaxone are only minimally altered with the half-life slightly increased (less than two fold), even in patients with severely impaired renal function.

The relatively modest increase in half-life in renal impairment is explained by a compensatory increase in non-renal clearance, resulting from a decrease in protein binding and corresponding increase in non-renal clearance of total ceftriaxone.

In patients with hepatic impairment, the elimination half-life of ceftriaxone is not increased, due to a compensatory increase in renal clearance. This is also due to an increase in plasma free fraction of ceftriaxone contributing to the observed paradoxical increase in total drug clearance, with an increase in volume of distribution paralleling that of total clearance.

Older people

In older people aged over 75 years the average elimination half-life is usually two to three times that of young adults.

Paediatric population

The half-life of ceftriaxone is prolonged in neonates. From birth to 14 days of age, the levels of free ceftriaxone may be further increased by factors such as reduced glomerular filtration and altered protein binding. During childhood, the half-life is lower than in neonates or adults.

The plasma clearance and volume of distribution of total ceftriaxone are greater in neonates, infants and children than in adults.

Linearity/non-linearity

The pharmacokinetics of ceftriaxone are non-linear and all basic pharmacokinetic parameters, except the elimination half-life, are dose dependent if based on total drug concentrations, increasing less than proportionally with dose. Non-linearity is due to saturation of plasma protein binding and is therefore observed for total plasma ceftriaxone but not for free (unbound) ceftriaxone.

Pharmacokinetic/pharmacodynamic relationship

As with other beta-lactams, the pharmacokinetic-pharmacodynamic index demonstrating the best correlation with *in vivo* efficacy is the percentage of the dosing interval that the unbound concentration remains above the minimum inhibitory concentration (MIC) of ceftriaxone for individual target species (i.e. %T > MIC).

Lidocaine

Absorption

Lidocaine is rapidly absorbed, with the absorption rate being dependent on the vascularity of the injection site.

Distribution

Lidocaine has a volume of distribution at steady state of 91 L.

Penetration into particular tissues. Lidocaine readily crosses the placenta, and equilibrium of unbound drug concentration is rapidly reached. The degree of plasma protein binding in the foetus is less than in the mother, which results in lower total plasma concentrations in the foetus.

Protein-binding. The plasma protein binding of lidocaine is concentration-dependent, and binding decreases as concentration increases. At concentrations of 1 to 5 µg/mL, 60%-80% lidocaine is protein bound. Binding is also dependent on the plasma concentration of the α 1-acid glycoprotein.

Lidocaine has been shown to cross the blood-brain barrier.

Biotransformation

Lidocaine is mainly metabolized by the liver. The main metabolites of lidocaine are monoethylglycine xylidide, glycinexylidide, 2,6-dimethylaniline, and 4-hydroxy-2,6-dimethylaniline. The lidocaine N-dealkylation to monoethylglycine xylidide is considered to be mediated by both CYP1A2 and CYP3A4. The metabolite 2,6-dimethylaniline is converted to 4-hydroxy-2,6-dimethylaniline by CYP2A6 and CYP2E1.

Elimination

The clearance of lidocaine in plasma following intravenous bolus administration is 9 to 10 mL/min/kg. The elimination half life of lidocaine following intravenous bolus injection is typically 1.5 to 2 hours.

Monoethylglycine xylidide has a half life of approximately 2.3 hours and glycinexylidide has a half life of about 10 hours and may accumulate after long-term administration.

Only 3% of lidocaine is excreted unchanged by the kidneys. About 73% of lidocaine appears in the urine as 4-hydroxy-2,6-dimethylaniline metabolite.

Patients with renal or hepatic impairment.

Following intravenous administration, the half life of lidocaine has approximately 3-fold increase in patients with liver impairment.

Mild to moderate renal impairment (CL_{cr} 30-60 mL/min) does not affect lidocaine pharmacokinetics but may increase the accumulation of glycinexylidide metabolite following intravenous administration. However, lidocaine clearance decreases about half and its half life is approximately doubled with increased accumulation of glycinexylidide metabolite in patients with severe renal impairment (CL_{cr} <30 mL/min).

The pharmacokinetics of lidocaine and its main metabolite of monoethylglycine xylidide are not altered significantly in haemodialysis patients who receive an intravenous dose of lidocaine.

5.3 Preclinical safety data

There is evidence from animal studies that high doses of ceftriaxone calcium salt led to formation of concrements and precipitates in the gallbladder of dogs and monkeys, which proved to be reversible. Animal studies produced no evidence of toxicity to reproduction and genotoxicity. Carcinogenicity studies on ceftriaxone were not conducted.

Preclinical studies on the combination of ceftriaxone and lidocaine have not been conducted.

6 PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Ceftriaxone powder: none

Lidocaine solvent: water for injections.

6.2 Incompatibilities

Based on literature reports, ceftriaxone is not compatible with amsacrine, vancomycin, fluconazole and aminoglycosides.

Solutions containing ceftriaxone should not be mixed with or added to other agents except those mentioned in section 6.6. In particular diluents containing calcium, (e.g. Ringer's solution, Hartmann's solution) should not be used to reconstitute ceftriaxone vials. Ceftriaxone must not be mixed or administered simultaneously with calcium containing solutions including total parenteral nutrition (see section 4.2, 4.3, 4.4 and 4.8).

If combination of another antibiotic with Rocephin is intended in the treatment, administration should not occur in the same syringe or in the same infusion solution.

6.3 Shelf life

Unopened vials or ampoules: 3 years

Chemical and physical in-use stability of the reconstituted product has been demonstrated for at least 6 hours at or below 25°C or 24 hours at 2-8°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 not be longer than the times stated above for the chemical and physical in-use stability.

6.4 Special precautions for storage

Do not store above 30°C. Keep the vials in the outer carton in order to protect from light.
For storage conditions after reconstitution of the medicinal product, see section 6.3.

6.5 Nature and contents of container

Ceftriaxone powder: glass vial with fluorobutyl rubber stopper and aluminium cap.
Lidocaine solvent: glass ampoule with 3.5 ml of solution.
Pack size of 1 vial and 1 ampoule.

6.6 Special precautions for disposal and other handling

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

Preparation of solutions for injection:

The use of freshly prepared solutions is recommended. For storage conditions of the reconstituted medicinal product, see section 6.3.

Rocephin should not be mixed in the same syringe with any drug other than 1% Lidocaine Hydrochloride solution (for intramuscular injection only).

Rocephin is completely reconstituted in its respective solution within 150 seconds. The reconstituted solution is a clear solution with a yellow to brownish-yellow colour.

Use in adults and children over 12 years of age (≥ 50 kg)

1 g Rocephin is dissolved in 3.5 ml of 1% Lidocaine Hydrochloride solution. The vial should be gently rolled between the palms, and visually inspected to ensure that reconstitution is complete and no particulate material is present. The solution should be administered by deep intramuscular injection. Dosages greater than 1 g should be divided and injected at more than one site.

Use in the paediatric population

Neonates, infants and children 15 days to 12 years of age (< 50 kg)

The displacement volume of 1 g of Rocephin is 0.71 ml in 1% lidocaine hydrochloride solution. This requires the offset of solvent volume to facilitate weight-dependent dosing (primarily in children up to 12 years), if only part of the total solution is measured and administered. To prepare a final solution concentration of 285 mg/ml, reconstitute 1 g of Rocephin in 2.9 ml of 1% lidocaine hydrochloride solution.

Dosages greater than 1 g should be divided and injected at more than one site.

See also the information in section 6.2.

7 MARKETING AUTHORISATION HOLDER

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