**AZACTAM® (aztreonam injection)**

**DESCRIPTION**

AZACTAM® (aztreonam injection) contains the active ingredient aztreonam, a monobactam. It was originally isolated from *Chromobacterium violaceum*. It is a synthetic bacterial antibiotic.

The monobactams, having a unique monocyclic beta-lactam nucleus, are structurally different from other beta-lactam antibiotics (e.g., penicillins, cephalosporins, cephapencems). The sulfonic acid substituent in the 1-position of the ring activates the beta-lactam moiety; an aminothiazolyloxime side chain in the 3-position and a methyl group in the 4-position confer the specific antibiotic spectrum and beta-lactamase stability.

Aztreonam is designated chemically as (2)-2-[[2-amino-4-thiazolyl]carbamoyl]methyltheneaminooxy]-2-methylpropionic acid.

Structural formula:

\[
\text{C}_6\text{H}_7\text{N}_2\text{O}_2\text{S}_2\text{ MW 435.44}
\]

AZACTAM in the GALAXY plastic container (PL 2040) is a frozen, iso-osmotic, sterile, sodium-free, nonpyrogenic intravenous solution. Each 50 mL of solution contains 1 g or 2 g aztreonam with approximately 1.7 g, or 700 mg Dextrose Hydrate, USP added to adjust osmolality, and approximately 780 mcg/mL, or 1.6 g of arginine added for pH adjustment, respectively. Thawed solutions have a pH in the range of 4.5 to 7.5. The solution is for intravenous administration following thawing at room temperature or under refrigeration.

This GALAXY container is fabricated from a specially designed multilayer plastic (PL 2040). Solutions are in contact with the polyethylene layer of this container and can leach out certain chemical components of the plastic in very small amounts within the expiration period. The suitability of the plastic has been confirmed in tests in animals according to the USP biological tests for plastic containers as well as by tissue culture toxicity studies.

**CLINICAL PHARMACOLOGY**

Single 30-minute intravenous infusions of 500 mg, 1 g, and 2 g doses of AZACTAM in healthy subjects produced aztreonam peak serum levels of 54 mcg/mL, 90 mcg/mL, and 135 mcg/mL, respectively (Figure 1). Single 3-minute intravenous infusions of 500 mg, 1 g, and 2 g doses of AZACTAM in healthy subjects produced aztreonam peak serum levels of 54 mcg/mL, 90 mcg/mL, and 135 mcg/mL, respectively (Figure 1).

Serum concentrations of aztreonam following completion of single intravenous infusions of 500 mg, 1 g, and 2 g doses are depicted in Figure 1.

**Table 1: Extravascular Concentrations of Aztreonam After a Single Intravenous (IV) Dose**

<table>
<thead>
<tr>
<th>Fluid or Tissue</th>
<th>Type</th>
<th>Route</th>
<th>Concentration (mcg/mL or mcg/g)</th>
<th>Hours Post-injection</th>
<th>Number of Patients</th>
<th>Mean Concentration (mcg/mL or mcg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bile</td>
<td></td>
<td>IV</td>
<td>0.1-16</td>
<td>2</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>blister fluid</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>1</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>bronchial secretion</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>4</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>cerebrospinal fluid</td>
<td></td>
<td>IV</td>
<td>0.9-4.3</td>
<td>16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>pericardial fluid</td>
<td></td>
<td>IV</td>
<td>0.1-1</td>
<td>6</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>pleural fluid</td>
<td></td>
<td>IV</td>
<td>1.1-3.0</td>
<td>3</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>synovial fluid</td>
<td></td>
<td>IV</td>
<td>0.6-1.9</td>
<td>11</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td><strong>Tissues</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>atrial appendage</td>
<td></td>
<td>IV</td>
<td>0.9-16</td>
<td>2</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>endometrium</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fallopian tube</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>fat</td>
<td></td>
<td>IV</td>
<td>1.3-2.0</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>femur</td>
<td></td>
<td>IV</td>
<td>1.0-2.1</td>
<td>15</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>gallbladder</td>
<td></td>
<td>IV</td>
<td>0.8-13</td>
<td>4</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>kidney</td>
<td></td>
<td>IV</td>
<td>2.4-5.6</td>
<td>5</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>large intestine</td>
<td></td>
<td>IV</td>
<td>0.8-19</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>liver</td>
<td></td>
<td>IV</td>
<td>0.9-2.0</td>
<td>6</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>lung</td>
<td></td>
<td>IV</td>
<td>1.2-2.1</td>
<td>6</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>myometrium</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>9</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>ovary</td>
<td></td>
<td>IV</td>
<td>0.7-19</td>
<td>7</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>skeletal muscle</td>
<td></td>
<td>IV</td>
<td>0.3-0.7</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>skin</td>
<td></td>
<td>IV</td>
<td>0.0-1.0</td>
<td>8</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>sternum</td>
<td></td>
<td>IV</td>
<td>0.1</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

- Tissue penetration is regarded as essential to therapeutic efficacy, but specific tissue levels have not been correlated with specific therapeutic effects.

The concentration of aztreonam in saliva at 30 minutes after a single 1 g intravenous dose (9 patients) was 0.2 mcg/mL; in human milk at 2 hours after a single 1 g intravenous dose (6 patients), 0.2 mcg/mL; in amniotic fluid at 6 to 8 hours after a single 1 g intravenous dose (5 patients), 2 mcg/mL. The concentration of aztreonam in peritoneal fluid obtained 1 to 6 hours after multiple 2 g intravenous doses ranged between 12 mcg/mL and 90 mcg/mL in 7 of 8 patients studied.
Aztreonam given intravenously rapidly reaches therapeutic concentrations in peritoneal dialysis fluid; conversely, aztreonam given intraperitoneally in dialysis fluid rapidly produces therapeutic serum levels. Concomitant administration of probenecid or furosemide and aztreonam causes clinically insignificant increases in the serum levels of aztreonam. Single-dose intravenous pharmacokinetic studies have not shown any significant interaction between aztreonam and concomitantly administered gentamicin, nafcillin sodium, cephradine, clindamycin, or metronidazole. No reports of disulfiram-like reactions with alcohol ingestion have been noted; this is not unexpected since aztreonam does not contain a methyl-tetrazole side chain.

Microbiology

Mechanism of Action
Aztreonam is a bactericidal agent that acts by inhibition of bacterial cell wall synthesis. Aztreonam has activity in the presence of some beta-lactamases, both penicillinases and cephalosporinases, of Gram-negative and Gram-positive bacteria.

Mechanism of Resistance
Resistance to aztreonam is primarily through hydrolysis by beta-lactamase, alteration of penicillin-binding proteins (PBPs), and decreased permeability.

Interaction with Other Antimicrobials
Aztreonam and aminoglycosides have been shown to be synergistic in vitro against most strains of P. aeruginosa, many strains of Enterobacteriaceae, and other Gram-negative aerobic bacilli.

Aztreonam has been shown to be active against most strains of the following microorganisms, both in vitro and in clinical infections as described in the INDICATIONS AND USAGE section.

Aerobic Gram-negative microorganisms:
- Citrobacter species
- Enterobacter species
- Escherichia coli
- Haemophilus influenzae (including ampicillin-resistant and other penicillinase-producing strains)
- Klebsiella oxytoca
- Klebsiella pneumoniae
- Proteus mirabilis
- Pseudomonas aeruginosa
- Serratia species, including S. marcescens

The following in vitro data are available, but their clinical significance is unknown. At least 90% of the following microorganisms exhibit an in vitro minimum inhibitory concentration (MIC) less than or equal to the susceptible breakpoint for aztreonam. However, the efficacy of aztreonam in treating clinical infections due to these microorganisms has not been established in adequate and well-controlled clinical trials.

Aerobic Gram-negative microorganisms:
- Aeromonas hydrophila
- Morganella morganii
- Neisseria gonorrhoeae (including penicillinase-producing strains)
- Pasteurella multocida
- Proteus vulgaris
- Providencia stuartii
- Providencia rettgeri
- Yersinia enterocolitica

Aztreonam and aminoglycosides have been shown to be synergistic in vitro against most strains of P. aeruginosa, many strains of Enterobacteriaceae, and other Gram-negative aerobic bacilli.

Alterations of the anaerobic intestinal flora by broad-spectrum antibiotics may decrease colonization resistance, thus permitting overgrowth of potential pathogens, eg, Candida and Clostridium species. Aztreonam has little effect on the anaerobic intestinal microflora in in vitro studies. Clostridium difficile and its cytotoxin were not found in animal models following administration of aztreonam. (See ADVERSE REACTIONS: Gastrointestinal.)

Susceptibility Test Methods
When available, the clinical microbiology laboratory should provide the results of in vitro susceptibility test results for antimicrobial drug products used in resident hospitals to the physician as periodic reports that describe the susceptibility profile of nosocomial and community-acquired pathogens. These reports should aid the physician in selecting an antibacterial drug product for treatment.

Dilution Techniques
Quantitative methods are used to determine antimicrobial MICs. These MICs provide estimates of the susceptibility of bacteria to antimicrobial compounds. The MICs should be determined using a standardized procedure. Standardized procedures are based on a dilution method (broth or agar) or equivalent with standardized inoculum concentrations and standardized concentrations of aztreonam powder. The MIC values should be interpreted according to the criteria in Table 2.

Diffusion Techniques
Quantitative methods that require measurement of zone diameters also provide reproducible estimates of the susceptibility of bacteria to antimicrobial compounds. The zone size provides an estimate of the susceptibility of bacteria to antimicrobial compounds. The zone size should be determined using a standardized test method. This procedure uses paper disks impregnated with 30 mcg aztreonam to test the susceptibility of microorganisms to aztreonam. The disk diffusion interpretive criteria are provided in Table 2.

Table 2: Susceptibility Test Interpretive Criteria for Aztreonam

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Minimum Inhibitory Concentrations (mcg/mL)</th>
<th>Disk Diffusion Zone Diameters (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(S)</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Entero bacteriaceae</td>
<td>≤4</td>
<td>8</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>≤2</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>≤8</td>
<td>16</td>
</tr>
</tbody>
</table>

* The current absence of data on resistant isolates precludes defining any category other than "Susceptible." If isolates yield MIC results other than susceptible, they should be submitted to a reference laboratory for additional testing.

Quality Control
Standardized susceptibility test procedures require the use of laboratory controls to monitor and ensure the accuracy and precision of supplies and reagents used in the assay, and the techniques of the individual performing the test. Standard aztreonam powder should provide the following range of MIC values noted in Table 3. For the diffusion technique using the 30 mcg disk, the criteria in Table 3 should be achieved.

Table 3: Acceptable Quality Control Ranges for Aztreonam

<table>
<thead>
<tr>
<th>QC Strain</th>
<th>Minimum Inhibitory Concentrations (mcg/mL)</th>
<th>Disk Diffusion Zone Diameters (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli ATCC 25922</td>
<td>0.06-0.25</td>
<td>28-36</td>
</tr>
<tr>
<td>Haemophilus influenzae ATCC 49247</td>
<td>0.12-5</td>
<td>30-38</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa ATCC 27853</td>
<td>2-8</td>
<td>23-29</td>
</tr>
</tbody>
</table>

INDICATIONS AND USAGE
To reduce the development of drug-resistant bacteria and maintain the effectiveness of AZACTAM (aztreonam injection) and other antibacterial drugs, AZACTAM should be used only to treat or prevent infections that are proven or strongly suspected to be caused by susceptible bacteria. When culture and susceptibility information are available, they should be considered in selecting or modifying antibacterial therapy. In the absence of such data, local epidemiology and susceptibility patterns may contribute to the empiric selection of therapy.

AZACTAM is indicated for the treatment of the following infections caused by susceptible Gram-negative microorganisms:

- Urinary Tract Infections (complicated and uncomplicated), including pyelonephritis and cystitis (initial and recurrent) caused by Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Enterobacter cloacae, Klebsiella oxytoca, Citrobacter species*, and Serratia marcescens*.
- Lower Respiratory Tract Infections, including pneumonia and bronchitis caused by Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Haemophilus influenzae, Proteus mirabilis, Enterobacter species, and Serratia marcescens*.
- Septicemia caused by Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus mirabilis*, Serratia marcescens*, and Enterobacter species.
- Skin and Skin-Structure Infections, including those associated with postoperative wounds, ulcers, and burns, caused by Escherichia coli, Proteus mirabilis, Serratia marcescens, Enterobacter species, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Citrobacter species*.
- Intra-abdominal Infections, including peritonitis caused by Escherichia coli, Klebsiella species including K. pneumoniae, Enterobacter species including E. cloacae*, Pseudomonas aeruginosa, Citrobacter species* including C. freundii*, and Serratia species* including S. marcescens*.
- Gynecologic Infections, including endometritis and pelvic cellulitis caused by Escherichia coli, Klebsiella pneumoniae*, Enterobacter species* including E. cloacae*, and Proteus mirabilis*.

* Efficacy for this organism in this organ system was studied in fewer than 10 infections.
AZACTAM® (aztreonam injection)

AZACTAM® is indicated for adjunctive therapy to surgery in the management of infections caused by susceptible organisms, including abscesses, infections complicating hollow viscus perforations, cutaneous infections, and infections of serous surfaces. AZACTAM® is effective against most of the commonly encountered Gram-negative aerobic pathogens seen in general surgery.

Concurrent Therapy

Concurrent initial therapy with other antimicrobial agents and AZACTAM® is recommended before the causative organism(s) is known in seriously ill patients who are also at risk of having an infection due to Gram-positive aerobic pathogens. If anaerobic organisms are also suspected as etiologic agents, therapy should be initiated using an anti-anaerobic agent concurrently with AZACTAM® (see DOSAGE AND ADMINISTRATION). Certain antibiotics (eg, cefoxitin, imipenem) may induce high levels of beta-lactamase in vitro in some Gram-negative aerobes such as Enterobacter and Pseudomonas species, resulting in antagonism to many beta-lactam antibiotics including aztreonam. These in vitro findings suggest that such beta-lactamase inducing antibiotics not be used concurrently with aztreonam. Following identification and susceptibility testing of the causative organism(s), appropriate antibiotic therapy should be continued.

CONTRAINDICATIONS

This preparation is contraindicated in patients with known hypersensitivity to aztreonam or any other component in the formulation.

WARNINGS

Both animal and human data suggest that AZACTAM® (aztreonam injection) is rarely cross-reactive with other beta-lactam antibiotics and weakly immunogenic. Treatment with aztreonam can result in hypersensitivity reactions in patients with or without prior exposure. (See CONTRAINDICATIONS.)

Careful inquiry should be made to determine whether the patient has any history of hypersensitivity reactions to any allergens. While cross-reactivity of aztreonam with other beta-lactam antibiotics is rare, this drug should be administered with caution to any patient with a history of hypersensitivity to beta-lactams (eg, penicillins, cephalosporins, and/or carbapenems). Treatment with aztreonam can result in hypersensitivity reactions in patients with or without prior exposure to aztreonam. If an allergic reaction to aztreonam occurs, discontinue the drug and institute supportive treatment as appropriate (eg, maintenance of ventilation, pressor amines, antihistamines, corticosteroids). Serious hypersensitivity reactions may require epinephrine and other emergency measures. (See ADVERSE REACTIONS.)

Clostridium difficile-associated diarrhea (CDAD) has been reported with use of nearly all antibacterial agents, including AZACTAM®, and may range in severity from mild diarrhea to fatal colitis. Treatment with antibacterial agents alters the normal flora of the colon leading to overgrowth of C. difficile.

C. difficile produces toxins A and B which contribute to the development of CDAD. Hypertoxic-producing strains of C. difficile cause increased morbidity and mortality, as these infections can be refractory to antimicrobial therapy and may require colectomy. CDAD must be considered in all patients who present with diarrhea following antibiotic exposure. (See CONTRAINDICATIONS.)

C. difficile is resistant to many antibiotics (eg, erythromycin). There is a potential for the overgrowth of C. difficile in the presence of antibiotic treatment.

C. difficile therapy should be initiated as clinically indicated. When considered necessary, appropriate fluid and electrolyte management, protein supplementation, antibiotic treatment of C. difficile, and surgical evaluation should be instituted as clinically indicated.

Rare cases of toxic epidermal necrolysis have been reported in association with aztreonam in patients undergoing bone marrow transplant with multiple risk factors including sepsis, radiation therapy, and other concomitantly administered drugs associated with toxic epidermal necrolysis.

PRECAUTIONS

General

Prescribing AZACTAM® in the absence of a proven or strongly suspected bacterial infection or a prophylactic indication is unlikely to provide benefit to the patient and increases the likelihood that bacteria will develop resistance and will not be treatable by AZACTAM® or other antibacterial drugs in the future.

Diarrhea is a common problem caused by antibiotics which usually ends when the antibiotic is discontinued. Sometimes after starting treatment with antibiotics, patients can develop watery and bloody stools (with or without stomach cramps and fever) even as late as 2 or more months after having taken the last dose of the antibiotic. If this occurs, patients should contact their physician as soon as possible.

Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenicity studies with aztreonam have not been conducted using an intravenous route of administration. A 104-week rat inhalation toxicity study to assess the carcinogenic potential of aztreonam demonstrated no drug-related increase in the incidence of tumors. Rats were exposed to aerosolized aztreonam for up to 4 hours per day. Peak plasma levels of aztreonam averaging approximately 6.8 mcg/mL were measured in rats at the highest dose level.

Genetic toxicity studies performed with aztreonam in vitro (Ames test, mouse lymphoma forward mutation assay, gene conversion assay, chromosome aberration assay in human lymphocytes) and in vivo (mouse bone marrow cytogenetic assay) did not reveal evidence of mutagenic or clastogenic potential.

A two-generation reproduction study in rats at daily doses of 150, 600, or 2400 mg/kg given prior to and during gestation and lactation, revealed no evidence of impaired fertility. Based on body surface area, the high dose is 2.3-fold greater than the maximum recommended human dose (MRHD) for adults of 8 g per day. There was a slightly reduced survival rate during the lactation period in the offspring of rats that received the high dose, but not in offspring of rats that received lower doses of aztreonam.

Pregnancy

Pregnancy Category B

In pregnant women, aztreonam crosses the placenta and enters the fetal circulation.

Developmental toxicity studies in pregnant rats and rabbits with daily doses of aztreonam up to 1800 and 1200 mg/kg, respectively, revealed no evidence of embryotoxicity or fetal toxicity. The highest dose used in this study, 1800 mg/kg/day, is 2.2 times the MRHD based on body surface area.

There are no adequate and well-controlled studies of aztreonam on human pregnancy outcomes. Because animal reproduction studies are not always predictive of human response, aztreonam should be used during pregnancy only if clearly needed.

Nursing Mothers

Aztreonam is excreted in human milk in concentrations that are less than 1% of the recommended human dose (MRHD) for adults of 8 g per day. There was a slightly reduced survival rate during the lactation period in the offspring of rats that received the high dose, but not in offspring of rats that received lower doses of aztreonam.

Pediatric Use

The safety and effectiveness of intravenous AZACTAM® have been established in the age groups 9 months to 16 years. Use of AZACTAM® in these age groups is supported by evidence from adequate and well-controlled studies of AZACTAM® in adults with additional efficacy, safety, and pharmacokinetic data from nonclinical controlled studies in pediatric patients. Sufficient data are not available for pediatric patients under 9 months of age or for the following treatment indications/pathogens: sepsisemia and skin and skin-structure infections (where the skin infection is believed or known to be due to H. influenzae type b). In pediatric patients with cystic fibrosis, higher doses of AZACTAM® may be warranted. (See CLINICAL PHARMACOLOGY, DOSAGE AND ADMINISTRATION, and CLINICAL STUDIES.)

Geriatric Use

Clinical studies of AZACTAM® did not include sufficient numbers of subjects aged 65 years and over to determine whether they respond differently from younger subjects. Other reported clinical experience has not identified differences in responses between the elderly and younger patients. In general, dose selection for an elderly patient should be cautious, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

In elderly patients, the mean serum half-life of aztreonam increased and the renal clearance decreased, consistent with the age-related decrease in creatinine clearance. Since aztreonam is known to be substantially excreted by the kidney, the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, renal function should be monitored and dosage adjustments made accordingly (see DOSAGE AND ADMINISTRATION: Renal Impairment in Adult Patients and Dosage in the Elderly).

AZACTAM® contains no sodium.
AZACTAM® (aztreonam injection)

ADVERSE REACTIONS

Local reactions (eg, phlebitis/thrombophlebitis; discomfort/swelling) following intravenous administration occurred at rates of approximately 1.9%.

Systemic reactions (considered to be related to therapy or of uncertain etiology) occurring at an incidence of 1% to 1.3% include diarrhea, nausea and/or vomiting, and rash. Reactions occurring at an incidence of less than 1% are listed within each body system in order of decreasing severity:

- Hypersensitivity—anaphylaxis, angioedema, bronchospasm
- Hematologic—pancytopenia, neutropenia, thrombocytopenia, anemia, eosinophilia, leukocytosis, thrombocytosis
- Gastrointestinal—abdominal cramps; rare cases of C. difficile-associated diarrhea, including pseudomembranous colitis, or gastrointestinal bleeding have been reported. Onset of pseudomembranous colitis symptoms may occur during or after antibiotic treatment. (See WARNINGS.)
- Dermatologic—toxic epidermal necrolysis (see WARNINGS), purpura, erythema multiforme, exfoliative dermatitis, urticaria, petechiae, pruritus, diaphoresis
- Cardiovascular—hypotension, transient ECG changes (ventricular bigeminy and PVC), flushing
- Respiratory—wheezing, dyspnea, chest pain
- Hepatobiliary—hepatitis, jaundice
- Nervous System—seizure, confusion, vertigo, paresthesia, insomnia, dizziness
- Musculoskeletal—muscular aches
- Special Senses—tinnitus, diplopia, mouth ulcer, altered taste, sneezing, nasal congestion, halitosis
- Other—vaginal candidiasis, vaginitis, breast tenderness

Body as a Whole—weakness, headache, fever, malaise

Pediatric Adverse Reactions

Of the 612 pediatric patients who were treated with AZACTAM in clinical trials, less than 1% required discontinuation of therapy due to adverse events. The following systemic adverse events, regardless of drug relationship, occurred in at least 1% of treated patients in domestic clinical trials: rash (4.3%), diarrhea (1.4%), and fever (1.0%). These adverse events were comparable to those observed in adult clinical trials.

In 343 pediatric patients receiving intravenous therapy, the following local reactions were noted: pain (12%), erythema (2.9%), induration (0.9%), and phlebitis (2.1%). In the US patient population, pain occurred in 1.5% of patients, while each of the remaining 3 local reactions had an incidence of 0.5%.

The following laboratory adverse events, regardless of drug relationship, occurred in at least 1% of treated patients: increased eosinophils (6.3%), increased platelets (3.6%), neutrophilia (3.2%), increased AST (3.8%), increased ALT (6.5%), and increased serum creatinine (5.8%).

In US pediatric clinical trials, neutropenia (absolute neutrophil count less than 1000/mm³) occurred in 11.3% of patients (6/71) younger than 2 years receiving 30 mg/kg every 6 hours. AST and ALT elevations to greater than 3 times the upper limit of normal were noted in 15% to 20% of patients aged 2 years or above receiving 50 mg/kg every 6 hours. The increased frequency of these reported laboratory adverse events may be due to either increased severity of illness treated or higher doses of AZACTAM administered.

Adverse Laboratory Changes

Adverse laboratory changes without regard to drug relationship that were reported during clinical trials were:

- Hepatic—elevations of AST (SGOT), ALT (SGPT), and alkaline phosphatase; signs or symptoms of hepatobiliary dysfunction occurred in less than 1% of recipients (see above).
- Hematologic—increases in prothrombin and partial thromboplastin times, positive Coombs’ test.
- Renal—increases in serum creatinine.

OVERDOSAGE

If necessary, aztreonam may be cleared from the serum by hemodialysis and/or peritoneal dialysis.

DOSAGE AND ADMINISTRATION

Dosage in Adult Patients

AZACTAM, an intravenous solution in GALAXY plastic containers (PL 2040), is intended for intravenous use only. Dosage should be determined by susceptibility of the causative organisms, severity and site of infection, and the condition of the patient.

Table 4: Azactam Dosage Guidelines for Adults*

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Dose</th>
<th>Frequency (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary tract infections</td>
<td>500 mg or 1 g</td>
<td>8 or 12</td>
</tr>
<tr>
<td>Moderately severe systemic infections</td>
<td>1 g or 2 g</td>
<td>8 or 12</td>
</tr>
<tr>
<td>Severe systemic or life-threatening infections</td>
<td>2 g</td>
<td>6 or 8</td>
</tr>
</tbody>
</table>

* Maximum recommended dose is 8 g per day.

Because of the serious nature of infections due to Pseudomonas aeruginosa, dosage of 2 g every six or eight hours is recommended, at least upon initiation of therapy, in systemic infections caused by this organism.

The intravenous route is recommended for patients requiring single doses greater than 1 g or those with bacterial septicemia, localized parenchymal abscess (eg, intra-abdominal abscess), peritonitis, or other severe systemic or life-threatening infections.

The duration of therapy depends on the severity of infection. Generally, AZACTAM should be continued for at least 48 hours after the patient becomes asymptomatic or evidence of bacterial eradication has been obtained. Persistent infections may require treatment for several weeks. Doses smaller than those indicated should not be used.

Renal Impairment in Adult Patients

Prolonged serum levels of aztreonam may occur in patients with transient or persistent renal insufficiency. Therefore, the dosage of AZACTAM should be halved in patients with estimated creatinine clearances between 10 and 30 mL/min/1.73 m² after an initial loading dose of 1 or 2 g.

When only the serum creatinine concentration is available, the following formula (based on sex, weight, and age of the patient) may be used to approximate the creatinine clearance (Clcr). The serum creatinine should represent a steady state of renal function.

Clcr = \[ \frac{\text{weight (kg) x (140–age)}}{72 \times \text{serum creatinine (mg/dL)}} \]

For males: Clcr = \[ \frac{\text{weight (kg) x (140–age)}}{72 \times \text{serum creatinine (mg/dL)}} \]

For females: 0.85 x above value

In patients with severe renal failure (creatinine clearance less than 10 mL/min/1.73 m²), such as those supported by hemodialysis, the usual dose of 500 mg, 1 g, or 2 g should be given initially. The maintenance dose should be one-fourth of the usual initial dose given at the usual fixed interval of 6, 8, or 12 hours. For serious or life-threatening infections, in addition to the maintenance doses, one-eighth of the initial dose should be given after each hemodialysis session.

Dosage in the Elderly

Renal status is a major determinant of dosage in the elderly; these patients in particular may have diminished renal function. Serum creatinine may not be an accurate determinant of renal status. Therefore, as with all antibiotics eliminated by the kidneys, estimates of creatinine clearance should be obtained and appropriate dosage modifications made if necessary.

Dosage in Pediatric Patients

AZACTAM should be administered intravenously to pediatric patients with normal renal function. There are insufficient data regarding intramuscular administration to pediatric patients or dosing in pediatric patients with renal impairment. (See PRECAUTIONS: Pediatric Use.)

Table 5: Azactam Dosage Guidelines for Pediatric Patients*

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Dose</th>
<th>Frequency (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild to moderate infections</td>
<td>30 mg/kg</td>
<td>8</td>
</tr>
<tr>
<td>Moderate to severe infections</td>
<td>30 mg/kg</td>
<td>6 or 8</td>
</tr>
</tbody>
</table>

* Maximum recommended dose is 120 mg/kg/day.

CLINICAL STUDIES

A total of 612 pediatric patients aged 1 month to 12 years were enrolled in uncontrolled clinical trials of aztreonam in the treatment of serious Gram-negative infections, including urinary tract, lower respiratory tract, skin and skin-structure, and intra-abdominal infections.

Directions for Use of AZACTAM (aztreonam injection) in GALAXY Plastic Container (PL 2040).

AZACTAM is to be administered as an intermittent intravenous infusion only.

Storage

Store in a freezer capable of maintaining a temperature of −20°C (−4°F).

Thawing of Plastic Containers

Thaw frozen container at room temperature, 25°C (77°F) or in a refrigerator, 2°C to 8°C (36°F–46°F). After thawing is complete, invert the container to assure a well-mixed solution. (DO NOT FORCE THAW BY IMMERSION IN WATER BATHS OR BY MICROWAVE IRRADIATION.)

Check for minute leaks by squeezing container firmly. If leaks are detected, discard solution as sterility may be impaired.

The container should be visually inspected. Thawed solutions should not be used unless clear; solutions will be colorless to yellow. Components of the solution may precipitate in the frozen state and will dissolve upon reaching room temperature with little or no agitation. If after visual inspection the solution remains discolored, cloudy, or if an insoluble precipitate is noted or if any seals or outlet ports are not intact, the container should be discarded.

DO NOT ADD SUPPLEMENTARY MEDICATION.

The thawed solution in GALAXY plastic container (PL 2040) remains chemically stable for either 14 days under refrigeration (2°C–8°C/36°F–46°F) or for 48 hours at room temperature (25°C/77°F). DO NOT REFREEZE THAWED ANTIBIOTICS.
AZACTAM® (aztreonam injection)

Preparation for Intravenous Administration

Use aseptic technique.

1. Suspend container(s) from eyelet support.
2. Remove protector from outlet port at bottom of container.
3. Attach administration set. Refer to complete directions accompanying set.

Additives or other medication should not be added to AZACTAM or infused simultaneously through the same intravenous line. If the same intravenous line is used for sequential infusion of several different drugs, it should be flushed before and after infusion of AZACTAM with an infusion solution compatible with AZACTAM (aztreonam injection) in GALAXY plastic container (PL 2040)* and any other drug(s) administered via this common line.

It is recommended that the intravenous administration apparatus be replaced at least once every 48 hours.

CAUTION: Do not use plastic containers in series connections. Such use could result in an embolism due to residual air being drawn from the primary container before administration of the fluid from the secondary container is complete.

Intravenous Administration

Infusion of AZACTAM should be completed within a 20- to 60-minute period. The plastic container is a single-dose unit; discard any unused portion remaining in the container.

*The following infusion solutions are compatible with AZACTAM (aztreonam injection) in GALAXY plastic container (PL 2040):

- Sodium Chloride Injection, USP, 0.9%
- Ringer’s Injection, USP
- Lactated Ringer’s Injection, USP
- Dextrose Injection, USP, 5% or 10%
- Dextrose and Sodium Chloride Injection, USP, 5%:0.9%, 5%:0.45%, or 5%:0.2%
- Sodium Lactate Injection, USP (M/6 Sodium Lactate)
- Isolyte® B and 5% Dextrose
- Isolyte® E
- Isolyte® E with 5% Dextrose
- Isolyte® M with 5% Dextrose
- Normosol®-R
- Normosol®-R and 5% Dextrose
- Normosol®-M and 5% Dextrose
- Mannitol Injection, USP, 5% or 10%
- Lactated Ringer’s and 5% Dextrose Injection
- Plasma-Lyte M and 5% Dextrose
- Isolyte® E
- Isolyte® M with 5% Dextrose
- Normosol®-R
- Normosol®-R and 5% Dextrose
- Normosol®-M and 5% Dextrose
- Mannitol Injection, USP, 5% or 10%
- Lactated Ringer’s and 5% Dextrose Injection
- Plasma-Lyte M and 5% Dextrose

HOW SUPPLIED

AZACTAM® (aztreonam injection) in GALAXY plastic container (PL 2040) is manufactured to Bristol-Myers Squibb specifications by:

Baxter Healthcare Corporation
Deerfield, IL 60015
for:
Bristol-Myers Squibb Company
Princeton, NJ 08543 USA

AZACTAM® and the Bristol-Myers Squibb logo are registered trademarks of Bristol-Myers Squibb Company.

All other trademarks are the property of their respective owners.

REFERENCES


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1266449A0 Rev June 2013
AZACTAM® (aztreonam for injection, USP)

To reduce the development of drug-resistant bacteria and maintain the effectiveness of AZACTAM® and other antibacterial drugs, AZACTAM should be used only to treat or prevent infections that are proven or strongly suspected to be caused by bacteria.

**DESCRIPTION**
AZACTAM® (aztreonam for injection, USP) contains the active ingredient aztreonam, a monobactam. It was originally isolated from Chromobacterium violaceum. It is a synthetic bactericidal antibacterial.

The monobactams, having a unique monocyclic beta-lactam nucleus, are structurally different from other beta-lactam antibiotics (eg, penicillins, cephalosporins, cephamycins). The sulfonic acid substituent in the 1-position of the ring activates the beta-lactam moiety; an aminothiazolyl oxime side chain in the 3-position and a methyl group in the 4-position confer the specific antibacterial spectrum and beta-lactamase stability.

Aztreonam is designated chemically as (Z)-2-[[[(2-amino-4-thiazolyl)\[(2S,3S)-2-methyl-4-oxo-1-sulfo-3-azetidinyl\]carbamoyl\]methylene\]amino\]oxy\]-2-methylpropionic acid.

Structural formula:

![Structural formula of aztreonam](https://example.com/structure.png)

AZACTAM is a sterile, nonpyrogenic, sodium-free, white powder containing approximately 780 mg arginine per gram of aztreonam. Following constipation, the product is for intramuscular or intravenous use. Aqueous solutions of the product have a pH in the range of 4.5 to 7.5.

**CLINICAL PHARMACOLOGY**

Single 30-minute intravenous infusions of 500 mg, 1 g, and 2 g doses of AZACTAM in healthy subjects produced aztreonam peak serum levels of 54 mcg/mL, 90 mcg/mL, and 204 mcg/mL, respectively, immediately after administration; at 8 hours, serum levels were 1 mcg/mL, 3 mcg/mL, and 6 mcg/mL, respectively (Figure 1). Single 3-minute intravenous injections of the same doses resulted in serum levels of 58 mcg/mL, 125 mcg/mL, and 242 mcg/mL at 5 minutes following completion of injection.

Serum concentrations of aztreonam in healthy subjects following completion of single intramuscular injections of 500 mg and 1 g doses are depicted in Figure 1; maximum serum concentrations occur at about 1 hour. After identical single intravenous or intramuscular doses of AZACTAM, the serum concentrations of aztreonam are comparable at 1 hour (1.5 hours from start of intravenous infusion) with similar slopes of serum concentrations thereafter.

**Figure 1: Extravascular Concentrations of Aztreonam After a Single Parenteral Dose**

<table>
<thead>
<tr>
<th>Fluid or Tissue</th>
<th>Dose (g)</th>
<th>Route</th>
<th>Hours Post-injection</th>
<th>Number of Patients</th>
<th>Mean Concentration (mcg/mL or mcg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bile</td>
<td>1</td>
<td>IV</td>
<td>2</td>
<td>10</td>
<td>39</td>
</tr>
<tr>
<td>blister fluid</td>
<td>1</td>
<td>IV</td>
<td>6</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>bronchial secret</td>
<td>2</td>
<td>IV</td>
<td>4</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>cephalosporin fluid</td>
<td>2</td>
<td>IV</td>
<td>0.9-4.3</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Average (infused meninges)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pericardial fluid</td>
<td>2</td>
<td>IV</td>
<td>1</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>pleural fluid</td>
<td>2</td>
<td>IV</td>
<td>1.1-3.0</td>
<td>3</td>
<td>51</td>
</tr>
<tr>
<td>synovial fluid</td>
<td>2</td>
<td>IV</td>
<td>0.8-1.9</td>
<td>11</td>
<td>83</td>
</tr>
<tr>
<td>Tissues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>atrial appendage</td>
<td>2</td>
<td>IV</td>
<td>0.9-1.6</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>endometrium</td>
<td>2</td>
<td>IV</td>
<td>0.7-1.9</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>fallopian tube</td>
<td>2</td>
<td>IV</td>
<td>0.7-1.9</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>fat</td>
<td>2</td>
<td>IV</td>
<td>1.3-2.0</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>femur</td>
<td>2</td>
<td>IV</td>
<td>1.0-2.1</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>gallbladder</td>
<td>2</td>
<td>IV</td>
<td>0.8-1.3</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>kidney</td>
<td>2</td>
<td>IV</td>
<td>2.4-5.6</td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td>large intestine</td>
<td>2</td>
<td>IV</td>
<td>0.8-1.9</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>liver</td>
<td>2</td>
<td>IV</td>
<td>0.9-2.0</td>
<td>6</td>
<td>47</td>
</tr>
<tr>
<td>lung</td>
<td>2</td>
<td>IV</td>
<td>1.2-2.1</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>myometrium</td>
<td>2</td>
<td>IV</td>
<td>0.7-1.9</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>ovary</td>
<td>2</td>
<td>IV</td>
<td>0.7-1.9</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>prostate</td>
<td>1</td>
<td>IM</td>
<td>0.8-3.0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>skeletal muscle</td>
<td>2</td>
<td>IV</td>
<td>0.3-0.7</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>skin</td>
<td>2</td>
<td>IV</td>
<td>0.8-1.0</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>sternum</td>
<td>2</td>
<td>IV</td>
<td>1</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

* Tissue penetration is regarded as essential to therapeutic efficacy, but specific tissue levels have not been correlated with specific therapeutic effects.

The concentration of aztreonam in saliva at 30 minutes after a single 1 g intravenous dose (9 patients) was 0.2 mcg/mL; in human milk at 2 hours after a single 1 g intravenous dose (6 patients), 0.2 mcg/mL, and at 6 hours after a single 1 g intramuscular dose (6 patients), 0.3 mcg/mL in anemic fluid at 6 to 8 hours after a single 1 g intravenous dose (5 patients), 2 mcg/mL. The concentration of aztreonam in peritoneal fluid obtained 1 to 6 hours after multiple 2 g intravenous doses ranged between 12 mcg/mL and 90 mcg/mL in 7 of 8 patients studied.
AZACTAM® (aztreonam for injection, USP)

Aztreonam given intravenously rapidly reaches therapeutic concentrations in peritoneal dialysis fluid; conversely, aztreonam given intraperitoneally in dialysis fluid rapidly produces therapeutic serum levels.

Concomitant administration of probenecid or furosemide and aztreonam causes clinically insignificant increases in the serum levels of aztreonam. Single-dose intravenous pharmacokinetic studies have not shown any significant interaction between aztreonam and concomitantly administered gentamicin, nafcillin sodium, cephradine, cildiamycin, or metronidazole. No reports of disulfiram-like reactions with alcohol ingestion have been noted; this is not unexpected since aztreonam does not contain a methyl-tetrazole side chain.

Microbiology

Mechanism of Action

Aztreonam is a bactericidal agent that acts by inhibition of bacterial cell wall synthesis. Aztreonam has activity in the presence of some beta-lactamases, both penicillinases and cephalosporinases, of Gram-negative and Gram-positive bacteria.

Mechanism of Resistance

Resistance to aztreonam is primarily through hydrolysis by beta-lactamase, alteration of penicillin-binding proteins (PBPs), and decreased permeability.

Interaction with Other Antimicrobials

Aztreonam and aminoglycosides have been shown to be synergistic in vitro against most strains of P. aeruginosa, many strains of Enterobacteriaceae, and other Gram-negative aerobic bacilli.

Aztreonam has been shown to be active against most strains of the following microorganisms, both in vitro and in clinical infections as described in the INDICATIONS AND USAGE section.

Aerobic Gram-negative microorganisms:

C. freundii

E. coli

H. influenzae (including ampicillin-resistant and other penicillinase-producing strains)

Klebsiella oxytoca

Klebsiella pneumoniae

Proteus mirabilis

P. aeruginosa

Serratia species

The following in vitro data are available, but their clinical significance is unknown. At least 90% of the following microorganisms exhibit an in vitro minimum inhibitory concentration (MIC) less than or equal to the susceptible breakpoint for aztreonam. However, the efficacy of aztreonam in treating clinical infections due to these microorganisms has not been established in adequate and well-controlled clinical trials.

Aerobic Gram-negative microorganisms:

Acinetobacter baumannii

Candida albicans

C. difficile

Corynebacterium species

Escherichia coli

Flavobacterium species

Klebsiella species

Legionella pneumophila

Listeria monocytogenes

Pseudomonas aeruginosa

Serratia marcescens

Shigella species

Staphylococcus species

Streptococcus species

Vibrio cholerae

Yersinia enterocolitica

Aztreonam and aminoglycosides have been shown to be synergistic in vitro against most strains of P. aeruginosa, many strains of Enterobacteriaceae, and other Gram-negative aerobic bacilli.

Alterations of the anaerobic intestinal flora by broad-spectrum antibiotics may decrease colonization resistance, thus permitting overgrowth of potential pathogens, eg, Candida and Clostridium species. Aztreonam has little effect on the anaerobic intestinal microflora in in vitro studies. Clostridium difficile and its cytotoxin were not found in animal models following administration of aztreonam. (See ADVERSE REACTIONS: Gastrointestinal.)

Susceptibility Test Methods

When available, the clinical microbiology laboratory should provide the results of in vitro susceptibility test results for antimicrobial drug products used in resident hospitals to the physician as periodic reports that describe the susceptibility profile of nosocomial and community-acquired pathogens. These reports should aid the physician in selecting an antibacterial drug product for treatment.

Dilution Techniques

Quantitative methods are used to determine antimicrobial MICs. These MICs provide estimates of the susceptibility of bacteria to antimicrobial compounds. The MICs should be determined using a standardized procedure. Standardized procedures are based on a dilution method (broth or agar) or equivalent with standardized inoculum concentrations and standardized concentrations of aztreonam powder. The MIC values should be interpreted according to the criteria in Table 2.

Diffusion Techniques

Quantitative methods that require measurement of zone diameters also provide reproducible estimates of the susceptibility of bacteria to antimicrobial compounds. The zone size provides an estimate of the susceptibility of bacteria to antimicrobial compounds. The zone size should be determined using a standardized test method. This procedure uses paper disks impregnated with 30 mcg aztreonam to test the susceptibility of microorganisms to aztreonam. The disk diffusion interpretive criteria are provided in Table 2.

Table 2: Susceptibility Test Interpretive Criteria for Aztreonam

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Minimum Inhibitory Concentrations (mcg/mL)</th>
<th>Disk Diffusion Zone Diameters (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(S) Susceptible</td>
<td>(I) Intermediate</td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>≤4</td>
<td>8</td>
</tr>
<tr>
<td>Haemophilus influenzae*</td>
<td>≤2</td>
<td>-</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>≤8</td>
<td>16</td>
</tr>
</tbody>
</table>

* The current absence of data on resistant isolates precludes defining any category other than "Susceptible." If isolates yield MIC results other than susceptible, they should be submitted to a reference laboratory for additional testing.

Quality Control

Standardized susceptibility test procedures require the use of laboratory controls to monitor and ensure the accuracy and precision of supplies and reagents used in the assay, and the techniques of the individual performing the test. Standard aztreonam powder should provide the following range of MIC values noted in Table 3. For the diffusion technique using the 30 mcg disk, the criteria in Table 3 should be achieved.

Table 3: Acceptable Quality Control Ranges for Aztreonam

<table>
<thead>
<tr>
<th>QC Strain</th>
<th>Minimum Inhibitory Concentrations (mcg/mL)</th>
<th>Disk Diffusion Zone Diameters (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli ATCC 25922</td>
<td>0.06-0.25</td>
<td>28-36</td>
</tr>
<tr>
<td>Haemophilus influenzae ATCC 49247</td>
<td>0.12-5</td>
<td>30-38</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa ATCC 27853</td>
<td>2-8</td>
<td>23-29</td>
</tr>
</tbody>
</table>

INDICATIONS AND USAGE

To reduce the development of drug-resistant bacteria and maintain the effectiveness of AZACTAM (aztreonam for injection, USP) and other antibacterial drugs, AZACTAM should be used only to treat or prevent infections that are proven or strongly suspected to be caused by susceptible bacteria. When culture and susceptibility information are available, they should be considered in selecting or modifying antibacterial therapy. In the absence of such data, local epidemiology and susceptibility patterns may contribute to the empiric selection of therapy.

AZACTAM is indicated for the treatment of the following infections caused by susceptible Gram-negative microorganisms:

Urinary Tract Infections (complicated and uncomplicated), including pyelonephritis and cystitis (initial and recurrent) caused by Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Enterobacter cloacae, Klebsiella oxytoca*, Citrobacter species*, and Serratia marcescens*.

Lower Respiratory Tract Infections, including pneumonia and bronchitis caused by Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Haemophilus influenzae, Proteus mirabilis, Enterobacter species, and Serratia marcescens*.

Septicemia caused by Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus mirabilis*, Serratia marcescens*, and Enterobacter species.

Skin and Skin-Structure Infections, including those associated with postoperative wounds, ulcers, and burns, caused by Escherichia coli, Proteus mirabilis, Serratia marcescens, Enterobacter species, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Citrobacter species*.

Intra-abdominal Infections, including peritonitis caused by Escherichia coli, Klebsiella species including K. pneumoniae, Enterobacter species including E. cloacae*, Pseudomonas aeruginosa, Citrobacter species* including C. freundii*, and Serratia species* including S. marcescens*.

Gynecologic Infections, including endometritis and pelvic cellulitis caused by Escherichia coli, Klebsiella pneumoniae*, Enterobacter species* including E. cloacae*, and Proteus mirabilis*.

* Efficacy for this organism in this organ system was studied in fewer than 10 infections.
AZACTAM® (aztreonam for injection, USP)

AZACTAM is indicated for adjunctive therapy to surgery in the management of infections caused by susceptible organisms, including abscesses, infections complicating hollow viscus perforations, cutaneous infections, and infections of serous surfaces. AZACTAM is effective against most of the commonly encountered Gram-negative aerobic pathogens seen in general surgery.

Concurrent Therapy

Concurrent initial therapy with other antimicrobial agents and AZACTAM is recommended before the causative organism(s) is known in seriously ill patients who are also at risk of having an infection due to Gram-positive aerobic pathogens. If anaerobic organisms are also suspected as etiologic agents, therapy should be initiated using an anti-anaerobic agent concurrently with AZACTAM (see DOSAGE AND ADMINISTRATION). Certain antibiotics (eg, cefoxitin, imipenem) may induce high levels of beta-lactamase (in vitro) in some Gram-negative aerobes such as Enterobacter and Pseudomonas species, resulting in antagonism to many beta-lactam antibiotics including aztreonam. These in vitro findings suggest that such beta-lactamase-inducing antibiotics not be used concurrently with aztreonam. Following identification and susceptibility testing of the causative organism(s), appropriate antibiotic therapy should be continued.

CONTRAINDICATIONS

This preparation is contraindicated in patients with known hypersensitivity to aztreonam or any other component in the formulation.

WARNINGS

Both animal and human data suggest that AZACTAM (aztreonam for injection, USP) is rarely cross-reactive with other beta-lactam antibiotics and weakly immunogenic. Treatment with aztreonam can result in hypersensitivity reactions in patients with or without prior exposure. (See CONTRAINDICATIONS.) Careful inquiry should be made to determine whether the patient has any history of hypersensitivity reactions to any allergens.

While cross-reactivity of aztreonam with other beta-lactam antibiotics is rare, this drug should be administered with caution to any patient with a history of hypersensitivity to beta-lactams (eg, penicillins, cephalosporins, and/or carbapenems). Treatment with aztreonam can result in hypersensitivity reactions in patients with or without prior exposure to aztreonam. If an allergic reaction to aztreonam occurs, discontinue the drug and institute supportive treatment as appropriate (eg, maintenance of ventilation, pressor amines, antihistamines, corticosteroids). Serious hypersensitivity reactions may require epinephrine and other emergency measures. (See ADVERSE REACTIONS.)

Clostridium difficile-associated diarrhea (CDAD) has been reported with use of nearly all antibacterial agents, including AZACTAM, and may range in severity from mild diarrhea to fatal colitis. Treatment with antibacterial agents alters the normal flora of the colon leading to overgrowth of C. difficile.

C. difficile produces toxins A and B which contribute to the development of CDAD. Hypertoxin-producing strains of C. difficile cause increased morbidity and mortality, as these infections can be refractory to antimicrobial therapy and may require colectomy. CDAD must be considered in all patients who present with diarrhea following antibiotic use. Careful medical history is necessary since CDAD has been reported to occur over 2 months after the administration of antibacterial agents. If CDAD is suspected or confirmed, ongoing antibiotic use not directed against C. difficile may need to be discontinued. Appropriate fluid and electrolyte management, protein supplementation, antibiotic treatment of C. difficile, and surgical evaluation should be instituted as clinically indicated.

Rare cases of toxic epidermal necrolysis have been reported in association with aztreonam in patients undergoing bone marrow transplant with multiple risk factors including sepsis, radiation therapy, and other concomitantly administered drugs associated with toxic epidermal necrolysis.

PRECAUTIONS

General

Prescribing AZACTAM in the absence of a proven or strongly suspected bacterial infection or a prophylactic indication is unlikely to provide benefit to the patient and increases the risk of the development of drug-resistant bacteria. In patients with impaired hepatic or renal function, appropriate monitoring is recommended during therapy.

If an aminoglycoside is used concurrently with aztreonam, especially if high dosages of the former are used or if therapy is prolonged, renal function should be monitored because of the potential nephrotoxicity and ototoxicity of aminoglycoside antibiotics.

The use of antibiotics may promote the overgrowth of nonsusceptible organisms, including Gram-positive organisms (Staphylococcus aureus and Streptococcus faecalis) and fungi. Should superinfection occur during therapy, appropriate measures should be taken.

Information for Patients

Patients should be counseled that antibacterial drugs including AZACTAM should only be used to treat bacterial infections. They do not treat viral infections (eg, the common cold). When AZACTAM is prescribed to treat a bacterial infection, patients should be told that although it is common to feel better early in the course of therapy, the medication should be taken exactly as directed. Skipping doses or not completing the full course of therapy may (1) decrease the effectiveness of the immediate treatment and (2) increase the likelihood that bacteria will develop resistance and will not be treatable by AZACTAM or other antibacterial drugs in the future.

Diabetes is a common problem caused by antibiotics which usually ends when the antibiotic is discontinued. Sometimes after starting treatment with antibiotics, patients can develop watery and bloody stools (with or without stomach cramps and fever) even as late as 2 or more months after having taken the last dose of the antibiotic. If this occurs, patients should contact their physician as soon as possible.

Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenicity studies with aztreonam have not been conducted using an intravenous route of administration. A 104-week rat oncogenicity study to assess the carcinogenic potential of aztreonam demonstrated no drug-related increase in the incidence of tumors. Rats were exposed to aerosolized aztreonam for up to 4 hours per day. Peak plasma levels of aztreonam averaging approximately 6.8 mcg/mL were measured in rats at the highest dose level.

Genetic toxicology studies performed with aztreonam in vitro (Ames test, mouse lymphoma forward mutation assay, gene conversion assay, chromosome aberration assay in human lymphocytes) and in vivo (mouse bone marrow cyto genetic assay) did not reveal evidence of mutagenicity or clastogenic potential.

A two-generation reproduction study in rats at daily doses of 150, 600, or 2400 mg/kg body weight prior to and during gestation and lactation, revealed no evidence of impaired fertility. Based on body surface area, the high dose is 2.9-fold greater than the maximum recommended human dose (MRHD) for adults of 8 g per day. There was a slightly reduced survival rate during the lactation period in the offspring of rats that received the high dose, but not in offspring of rats that received lower doses of aztreonam.

Pregnancy

Pregnancy Category B

In pregnant women, aztreonam crosses the placenta and enters the fetal circulation. Developmental toxicity studies in pregnant rats and rabbits with daily doses of aztreonam up to 1800 and 1200 mg/kg, respectively, revealed no evidence of embryotoxicity or fetotoxicity or teratogenicity. These doses, based on body surface area, are 2.2- and 2.9-fold greater than the MRHD for adults of 8 g per day. A peri/postnatal study in rats revealed no drug-induced changes in any maternal, fetal, or neonatal parameters. The highest dose used in this study, 1800 mg/kg/day, is 2.2 times the MRHD based on body surface area.

There are no adequate and well-controlled studies of aztreonam on human pregnancy outcomes. Because animal reproduction studies are not always predictive of human response, aztreonam should be used during pregnancy only if clearly needed.

Nursing Mothers

Aztreonam is excreted in human milk in concentrations that are less than 1% of concentrations determined in simultaneously obtained maternal serum; consideration should be given to temporary discontinuation of nursing and use of formula feedings.

Pediatric Use

The safety and effectiveness of intra venous AZACTAM have been established in the age groups 9 months to 16 years. Use of AZACTAM in these age groups is supported by evidence from adequate and well-controlled studies of AZACTAM in adults with additional efficacy, safety, and pharmacokinetic data from noncomparative clinical studies in pediatric patients. Sufficient data are not available for pediatric patients under 9 months of age or for the following treatment indications/pathogens: septicemia and skin and skin-structure infections (where the skin infection is believed or known to be due to H. influenzae type b). In pediatric patients with cystic fibrosis, higher doses of AZACTAM may be warranted. (See CLINICAL PHARMACOLOGY, DOSAGE AND ADMINISTRATION, and CLINICAL STUDIES.)

Geriatric Use

Clinical studies of AZACTAM did not include sufficient numbers of subjects aged 65 years and over to determine whether they respond differently from younger subjects. Other reported clinical experience has not identified differences in responses between the elderly and younger patients.

In general, dose selection for an elderly patient should be cautious, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

In elderly patients, the mean serum half-life of aztreonam increased and the renal clearance decreased, consistent with the age-related decrease in creatinine clearance. 1-4 In elderly patients are more likely to have decreased renal function. Because elderly patients are more likely to have decreased renal function, renal function should be monitored and dosage adjustments made accordingly (see DOSAGE AND ADMINISTRATION: Renal Impairment in Adult Patients and Dosage in the Elderly).

AZACTAM contains no sodium.
AZACTAM® (aztreonam for injection, USP)

ADVERSE REACTIONS

Local reactions such as phlebitis/thrombophlebitis following intravenous administration, and discomfort/swelling at the injection site following intramuscular administration occurred at rates of approximately 1.9% and 2.4%, respectively.

Systemic reactions (considered to be related to therapy or of uncertain etiology) occurring at an incidence of 1% to 1.3% include diarrhea, nausea and/or vomiting, and rash. Reactions occurring at an incidence of less than 1% are listed within each body system in order of decreasing severity:

Hypersensitivity—anaphylaxis, angioedema, bronchospasm

Hematologic—pancytopenia, neutropenia, thrombocytopenia, anemia, eosinophilia, leukocytosis, thrombosis, granulocytosis, neutropenia, lymphopenia

Gastrointestinal—abdominal cramps; rare cases of C. difficile-associated diarrhea, including pseudomembranous colitis, or gastrointestinal bleeding have been reported. Onset of pseudomembranous colitis symptoms may occur during or after antibiotic treatment. (See WARNINGS.)

Dermatologic—toxic epidermal necrolysis (see WARNINGS), purpura, erythema multiforme, exfoliative dermatitis, urticaria, petechiae, pruritus, diaphoresis

Cardiovascular—hypotension, transient ECG changes (ventricular bigeminy and PVC), flushing

Respiratory—wheezing, dyspnea, chest pain

Hepatobiliary—hepatitis, jaundice

Nervous System—seizure, confusion, vertigo, paresthesia, insomnia, dizziness

Musculoskeletal—muscular aches

Special Senses—tinnitus, diplopia, mouth ulcer, altered taste, numb tongue, sneezing, nasal congestion, hallucosis

Other—vaginal candidiasis, vaginitis, breast tenderness

Body as a Whole—weakness, headache, fever, malaise

Pediatric Adverse Reactions

Of the 612 pediatric patients who were treated with AZACTAM in clinical trials, less than 1% required discontinuation of therapy due to adverse events. The following systemic adverse events, regardless of drug relationship, occurred in at least 1% of treated patients in domestic clinical trials: rash (4.3%), diarrhea (1.4%), and fever (1.0%). These adverse events were comparable to those observed in adult clinical trials.

In 343 pediatric patients receiving intravenous therapy, the following local reactions were noted: pain (12%), erythema (2.9%), induration (0.9%), and phlebitis (2.1%). In the US patient population, pain occurred in 1.5% of patients, while each of the remaining 3 local reactions had an incidence of 0.5%.

Adverse Laboratory Changes

Adverse laboratory changes without regard to drug relationship that were reported during clinical trials were:

Hepatic—elevations of AST (SGOT), ALT (SGPT), and alkaline phosphatase; signs or symptoms of hepatobiliary dysfunction occurred in less than 1% of recipients (see above).

Hematologic—increases in prothrombin and partial thromboplastin times, positive Coombs’ test.

Renal—increases in serum creatinine.

OVERDOSAGE

If necessary, aztreonam may be cleared from the serum by hemodialysis and/or peritoneal dialysis.

DOSAGE AND ADMINISTRATION

Dosage in Adult Patients

AZACTAM may be administered intravenously or by intramuscular injection. Dosage and route of administration should be determined by susceptibility of the causative organisms, severity and site of infection, and the condition of the patient.

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Dose</th>
<th>Frequency (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary tract infections</td>
<td>500 mg or 1 g</td>
<td>8 or 12</td>
</tr>
<tr>
<td>Moderately severe systemic infections</td>
<td>1 g or 2 g</td>
<td>8 or 12</td>
</tr>
<tr>
<td>Severe systemic or life-threatening infections</td>
<td>2 g</td>
<td>6 or 8</td>
</tr>
</tbody>
</table>

* Maximum recommended dose is 8 g per day.

Dosage in Pediatric Patients

AZACTAM should be administered intravenously to pediatric patients with normal renal function. There are insufficient data regarding intramuscular administration to pediatric patients or dosing in pediatric patients with renal impairment. (See PRECAUTIONS: Pediatric Use.)

Table 5: Azactam Dosage Guidelines for Pediatric Patients*

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Frequency (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild to moderate infections</td>
<td>30 mg/kg</td>
</tr>
<tr>
<td>Moderate to severe infections</td>
<td>30 mg/kg</td>
</tr>
</tbody>
</table>

* Maximum recommended dose is 120 mg/kg/day.

CLINICAL STUDIES

A total of 612 pediatric patients aged 1 month to 12 years were enrolled in uncontrolled clinical trials of aztreonam in the treatment of serious Gram-negative infections, including urinary tract, lower respiratory tract, skin and skin-structure, and intra-abdominal infections.

Preparation of Parenteral Solutions

General

Upon the addition of the diluent to the container, contents should be shaken immediately and vigorously. Constituted solutions are not for multiple-dose use; should the entire volume in the container not be used for a single dose, the unused solution must be discarded.

Depending upon the concentration of aztreonam and diluent used, constituted AZACTAM yields a colorless to light straw yellow solution which may develop a slight pink tint on standing (pH does not change). Parenteral drug products should be inspected visually for particulate matter and discoloration whenever solution and container permit.

Admixtures with Other Antibiotics

Intravenous infusion solutions of AZACTAM not exceeding 2% w/v prepared with Sodium Chloride Injection, USP 0.9% or Dextrose Injection, USP 5%, to which clindamycin phosphate, gentamicin sulfate, tobramycin sulfate, or cefazolin sodium have been added at concentrations usually used clinically, are stable for up to 48 hours at room temperature or 7 days under refrigeration. Ampicillin sodium admixtures with aztreonam in Sodium Chloride Injection, USP 0.9% are stable for 24 hours at room temperature and 48 hours under refrigeration; stability in Dextrose Injection, USP 5% is 2 hours at room temperature and 8 hours under refrigeration.

Aztreonam-cloxacillin sodium and aztreonam-vancomycin hydrochloride admixtures are stable in Dineal 137 (Peritoneal Dialysis Solution) with 4.25% Dextrose up to 24 hours at room temperature.
AZACTAM® (aztreonam for injection, USP)

Aztreonam is incompatible with nafcillin sodium, cephradine, and metronidazole. Other admixtures are not recommended since compatibility data are not available.

**Intravenous Solutions**

For **Bolus Injection**: The contents of an AZACTAM 15 mL capacity vial should be constituted with 6 to 10 mL Sterile Water for Injection, USP.

For **Infusion**: If the contents of a 15 mL capacity vial are to be transferred to an appropriate infusion solution, each gram of aztreonam should be initially constituted with at least 3 mL Sterile Water for Injection, USP. Further dilution may be obtained with one of the following intravenous infusion solutions:

- Sodium Chloride Injection, USP, 0.9%
- Ringer’s Injection, USP
- Lactated Ringer’s Injection, USP
- Dextrose and Sodium Chloride Injection, USP, 5%:0.9%, 5%:0.45%, or 5%:0.2%
- Sodium Lactate Injection, USP (M/6 Sodium Lactate)
- Ionosot® B and 5% Dextrose
- Isolette® E
- Isolette® E with 5% Dextrose
- Isolette® M with 5% Dextrose
- Normosol®-R
- Normosol®-R and 5% Dextrose
- Normosol®-M and 5% Dextrose
- Mannitol Injection, USP, 5% or 10%
- Lactated Ringer’s and 5% Dextrose Injection
- Plasma-Lyte M and 5% Dextrose

**Intramuscular Solutions**

The contents of an AZACTAM 15 mL capacity vial should be constituted with at least 3 mL of an appropriate diluent per gram aztreonam. The following diluents may be used:

- Sterile Water for Injection, USP
- Sterile Bacteriostatic Water for Injection, USP (with benzyl alcohol or with methyl- and propylparabens)
- Sodium Chloride Injection, USP, 0.9%
- Bacteriostatic Sodium Chloride Injection, USP (with benzyl alcohol)

**Stability of Intravenous and Intramuscular Solutions**

AZACTAM solutions for intravenous infusion at concentrations not exceeding 2% w/v must be used within 48 hours following constitution if kept at controlled room temperature (59°F–86°F/15°C–30°C) or within 7 days if refrigerated (36°F–46°F/2°C–8°C).

AZACTAM solutions at concentrations exceeding 2% w/v, except those prepared with Sterile Water for Injection, USP or Sodium Chloride Injection, USP, should be used promptly after preparation; the 2 excepted solutions must be used within 48 hours if stored at controlled room temperature or within 7 days if refrigerated.

**Intravenous Administration**

**Bolus Injection**: A bolus injection may be used to initiate therapy. The dose should be slowly injected directly into a vein, or the tubing of a suitable administration set, over a period of 3 to 5 minutes (see next paragraph regarding flushing of tubing).

**Infusion**: With any intermittent infusion of aztreonam and another drug with which it is not pharmaceutically compatible, the common delivery tube should be flushed before and after delivery of aztreonam with any appropriate infusion solution compatible with both drug solutions; the drugs should not be delivered simultaneously. Any AZACTAM infusion should be completed within a 20- to 60-minute period. With use of a Y-type administration set, careful attention should be given to the calculated volume of aztreonam solution required so that the entire dose will be infused. A volume control administration set may be used to deliver an initial dilution of AZACTAM (see Preparation of Parenteral Solutions: Intravenous Solutions: For Infusion) into a compatible infusion solution during administration; in this case, the final dilution of aztreonam should provide a concentration not exceeding 2% w/v.

**Intramuscular Administration**

The dose should be given by deep injection into a large muscle mass (such as the upper outer quadrant of the gluteus maximus or lateral part of the thigh). Aztreonam is well tolerated and should not be admixed with any local anesthetic agent.

**HOW SUPPLIED**

**AZACTAM® (aztreonam for injection, USP)**

Single-dose 15 mL capacity vials:

- 1 g/vial: Packages of 10 NDC 0003-2560-16
- 2 g/vial: Packages of 10 NDC 0003-2570-16

**Storage**

Store original packages at room temperature; avoid excessive heat.

**REFERENCES**


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