Aminopenicillin Mechanisms

Aminopenicillins are antibiotics that belong to the penicillin family. Like penicillins, aminopenicillins are beta-lactam antibiotics that work by inhibiting bacterial cell wall synthesis. They are classified as bactericidal agents. Aminopenicillins have a broader spectrum of activity than penicillin. They are not degraded by acid hydrolysis and can, therefore, be administered orally. Aminopenicillins are susceptible to beta-lactamase, which is why they are often given with beta-lactamase inhibitors like clavulanic acid. Aminopenicillins are used to treat most gram-positive infections and some gram-negative infections, such as Escherichia coli and Haemophilus influenzae. Common aminopenicillins include ampicillin and amoxicillin. Adverse reactions include hypersensitivity reactions, ampicillin rash when given to patients with infectious mononucleosis, and pseudomembranous colitis.

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Indications

Broader Spectrum
Broad Spectrum of Colors
Aminopenicillins have a wider spectrum of coverage than penicillins because they are effective against many gram-positive bacteria (e.g., Streptococcus species and Enterococcus faecalis) and some gram-negative bacteria (e.g., Escherichia coli, Haemophilus influenzae, Proteus mirabilis, Salmonella, and Shigella).

Drug Names

Ampicillin
Amp-pencil
Ampicillin is a beta-lactam antibiotic in the aminopenicillin family. It can be used against gram-positive organisms and limited gram-negative bacteria. It can sometimes cause a non-immune mediated rash if accidentally used for patients with mononucleosis.

Amoxicillin
Armor-ox-pencil
Amoxicillin is a popular oral beta-lactam antibiotic used for infections such as otitis media, skin infections, and strep throat. It is susceptible to degradation by beta-lactamase-producing bacteria and is, therefore, often combined with beta-lactamase inhibitors like clavulanic acid.

Mechanism and Characteristics

Beta-Lactamase Sensitive
Black-beta-fish-ace Crying
Beta-lactamase is an enzyme that is produced by some bacteria to cleave beta-lactam antibiotics, rendering them ineffective. When an antibiotic is described as beta-lactamase sensitive, that means it is likely ineffective against beta-lactamase-producing bacteria. Beta-lactamase inhibitors are commonly combined with penicillin group antibiotics to overcome resistance to these enzymes, and commonly used beta-lactamase inhibitors include clavulanic acid, sulbactam, and tazobactam.

Combine with Clavulanic Acid
Cleaver Acidic-lemon
Clavulanic acid is a beta-lactamase inhibitor commonly combined with penicillin group antibiotics to overcome resistance in bacteria that secrete beta-lactamase to inactivate most penicillins. Clavulanic acid shares a similar beta-lactam ring structure and is called a suicide inhibitor because it covalently binds to the active site of beta-lactamase, thus inactivating it. Clavulanic acid is commonly combined with amoxicillin and is called Augmentin. When combined with amoxicillin, it extends the drug's spectrum to include beta-lactamase-producing strains of Haemophilus influenzae, Moraxella catarrhalis, and Staphylococcus aureus (non-MRSA).

Side Effects

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Hypersensitivity Reactions

Hiker-sensitive-crying

Because penicillins and aminopenicillins are relatively similar in structure, individuals with hypersensitivity reactions to penicillins may also demonstrate a hypersensitivity or anaphylactic reaction to aminopenicillins. Hypersensitivity reactions to aminopenicillins include type I (immediate) reactions like anaphylaxis and type IV (delayed) reactions like maculopapular rash. These reactions occur due to immune cross-reactivity with penicillins. Skin testing may be necessary to confirm allergies, especially in patients with a history of severe reactions.

Ampicillin Rash

Amp-pencil Rash with Dermatologist

Ampicillin rash is a non-allergic, maculopapular rash that develops in patients with Epstein-Barr virus (infectious mononucleosis) when treated with ampicillin. Patients with infectious mononucleosis are sometimes misdiagnosed with streptococcal pharyngitis due to the similarity of symptoms and are given antibiotics like ampicillin. This maculopapular rash is non-IgE-mediated and typically appears 5-10 days after starting ampicillin in patients with EBV. It is not a true allergy and does not contraindicate future beta-lactam use.

Pseudomembranous Colitis

Sumo-man-bra Colon

Pseudomembranous colitis is a severe form of antibiotic-associated diarrhea caused by overgrowth of Clostridioides difficile (formerly known as Clostridium difficile). Aminopenicillins like ampicillin are moderate-risk antibiotics for precipitating this condition due to disruption of normal gut flora. Symptoms include foul-smelling diarrhea, fever, and abdominal pain. Diagnosis is confirmed by detecting C. difficile toxins in the stool.

Diarrhea

Toilet

Diarrhea is a common side effect associated with these medications; however, amoxicillin causes less diarrhea than ampicillin. It is important to note that this diarrhea is not caused by Clostridium difficile infection. Patients should be encouraged to consume probiotic-rich foods, such as yogurt, to reduce the incidence of diarrhea while taking antibiotics.

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