

BETA-LACTAMS | PENICILLIN

Inhibit bacterial cell wall synthesis

by interfering with the transpeptidation reaction, halting peptidoglycan synthesis causing cellular lysis and bacterial death



EXAMPLES

NATURAL PENICILLIN

- Penicillin G (benzylpenicillin)
- Penicillin G benzathine*
- Penicillin G procaine*
- Penicillin V (phenoxymethylpenicillin)

*Intramuscular, long-acting formulations

Indications

Pharyngitis
Cellulitis
Rheumatic fever
Pneumonia
Streptococcal endocarditis
Pneumococcal, meningococcal meningitis
Puerperal infection
Syphilis

COVERAGE

Gram positive cocci

- Streptococcus pneumoniae
- Streptococcus pyogenes
- Viridans streptococci

Gram positive rods

Gram negative cocci

- Neisseria gonorrhoeae
- Neisseria meningitidis

Anaerobic

- Clostridium sp.

Spirochetes

- Treponema pallidum



Susceptible to beta-lactamase

BETA-LACTAMS | PENICILLIN

EXAMPLES

COVERAGE

ANTI-STAPHYLOCOCCAL PENICILLIN

- Methicillin
- Flucloxacillin
- Dicloxacillin
- Nafcillin
- Oxacillin

- Staphylococci
- Streptococci

Indications
Use restricted to β -lactamase-producing staph incl. MSSA

Resistant to staphylococcal beta-lactamase

EXTENDED SPECTRUM PENICILLIN

Aminopenicillins

- Ampicillin
- Amoxicillin

Antipseudomonal penicillins

- Piperacillin

- Similar coverage as natural penicillins
- Gram-negative rods

Susceptible to beta-lactamase

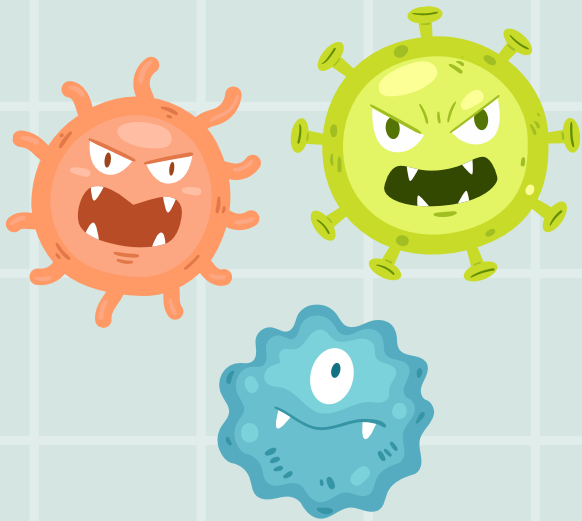


SIDE EFFECTS

- Hypersensitivity reaction (rash, angioedema, anaphylaxis)
- Diarrhoea (C. difficile)
- Neurotoxicity (seizures)

BETA-LACTAMASE INHIBITORS + PENICILLIN

β -lactamase



Enzyme produced by bacteria
to hydrolyze the β -lactam
ring, thus inactivating
 β -lactam antibiotics

*Almost all Staph. aureus naturally
express these enzymes*

Block β -lactamase enzyme,
allowing penicillins to avoid
destruction and extending
its spectrum of activity

β -lactamase inhibitors



BETA-LACTAMASE INHIBITORS + PENICILLIN

EXAMPLES

AUGMENTIN → Amoxicillin + Clavulanic Acid

UNASYN → Ampicillin + Sulbactam

TAZOCIN → Piperacillin + Tazobactam

β -lactamase inhibitors underlined

COVERAGE

- Same coverage as penicillins but broadened
- Anaerobic bacteria
- MSSA
- Enteric organisms (e.g. some resistant E. coli)
- Pseudomonas aeruginosa (Tazocin only)



SIDE EFFECTS

Similar as penicillins



BETA-LACTAMS

CEPHALOSPORINS

β -lactam antibiotics closely related structurally and functionally to penicillins

FIRST GENERATION

Cefazolin, Cephalexin

Gram (+) cocci

- Staphylococci (MSSA only)
- Streptococci
- Anaerobic streptococci

Gram (-) rods

- E. coli
- Klebsiella pneumoniae
- Proteus mirabilis

SECOND GENERATION

Cefuroxime, Cefaclor

First generation coverage

+

Extended gram (-) coverage

- Haemophilus influenzae
- E. coli
- Klebsiella pneumoniae
- Proteus mirabilis

THIRD GENERATION

Ceftriaxone, Cefotaxime

Extended gram (-) coverage

Including β -lactamase-producing strains of *Haemophilus* and *Neisseria*

Indications
Bacterial meningitis

FOURTH GENERATION

Cefepime

Gram (+) cocci

- *Staphylococci* (MSSA only)
- *Streptococci*

Gram (-) coverage

- *Enterobacter* sp.
- *Pseudomonas aeruginosa*
- *Haemophilus influenzae*
- *Neisseria* sp.
- *E. coli*
- *Klebsiella pneumoniae*
- *Proteus mirabilis*

FIFTH GENERATION

Ceftaroline

- MRSA
- *Streptococci*
- Broad gram (-) spectrum like ceftriaxone



SIDE EFFECTS

Allergy

- Skin rashes
- Fever
- Anaphylaxis
- Cross-allergenicity between penicillin and cephalosporin

Toxicity

- Local irritation: pain after IM, thrombophlebitis after IV
- Renal toxicity: interstitial nephritis and tubular necrosis (uncommon)

BETA-LACTAMS | CARBAPENEMS

Synthetic β -lactam antibiotics



EXAMPLE

- Imipenem
- Meropenem
- Doripenem
- Ertapenem

SIDE EFFECTS

- Nausea, vomiting, diarrhoea
- Seizures (high levels of imipenem)
- Similar to other β -lactams: morbilliform rash, anaphylaxis

COVERAGE

Gram-positive

- Streptococci
- Staphylococci

Aerobic gram-negative rods

- *Pseudomonas aeruginosa*

Most anaerobes



GLYCOPEPTIDES

Inhibit bacterial cell wall synthesis
by binding to peptidoglycan precursors,
disrupting polymerization and cross-linking



EXAMPLE

Vancomycin

COVERAGE

**Aerobic & anaerobic
gram-positive:**

- MRSA
- MRSE
- Streptococcus
- Enterococcus
- Clostridium



SIDE EFFECTS

- Nephrotoxicity
- Ototoxicity
- Infusion-related reactions
(phlebitis, chills, fever,
red man syndrome)

References

1. Basic Clinical Pharmacology 14th Ed., Bertram G. Katzung
2. Lippincott Illustrated Reviews: Pharmacology
3. Antibiotic stewardship handbook



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