Beta-Lactam Antibiotics

1. Following is NOT an example of Carbapenem [GPAT-2023 SHIFT-I]

(a) Thienamycin (b) Imipenem (c) Piperacillin (d) Meropenem

2. hich of the following urinary tract anti-infective agents requires an acidic pH of urine for optimum action [GPAT-2023 SHIFT-I]

(a) Gentamicin (b) Erythromycin (c) Carbenicillin (d) Streptomycin

3. Which of the following is a fourth-generation cephalosporin [GPAT-2023 SHIFT-I]

(a) Ceftriaxone (b) Cefaclor (c) Cefuroxime (d) Cefepime

4. Which of the following is a third generation Cephalosporin [GPAT-2023 SHIFT-II]

(a) Cefazolin (b) Cefuroxime (c) Cefotaxime (d) Cefepime

5. Select the β-lactamase inhibitor [GPAT-2011, 2018]

(a) Griseofulvin (b) Clavulanic acid (c) Sulfamethoxazole (d) Tetracycline

6. Clavulanic acid is [GPAT-2017]

(a) Inactivates bacterial β-lactamase (b) Potent Inhibitor of peptidoglycan synthesis

(c) Specific for gram negative bacteria (d) Inhibitor of 50S ribosomal subunit

7. All have beta lactam ring EXCEPT

(a) Penicillin (b) Linezolid (c) Cefotaxime (d) Imipenem

8. Penicillin is the metabolic product of

(a) Aminoadipic acid (b) Aminocaproic acid

(c) Levulinic acid (d) Arachidonic acid

9. The following is not a penicillinase resistant Penicillin

(a) Methicillin (b) Ampicillin (c) Oxacillin (d) Nafcillin

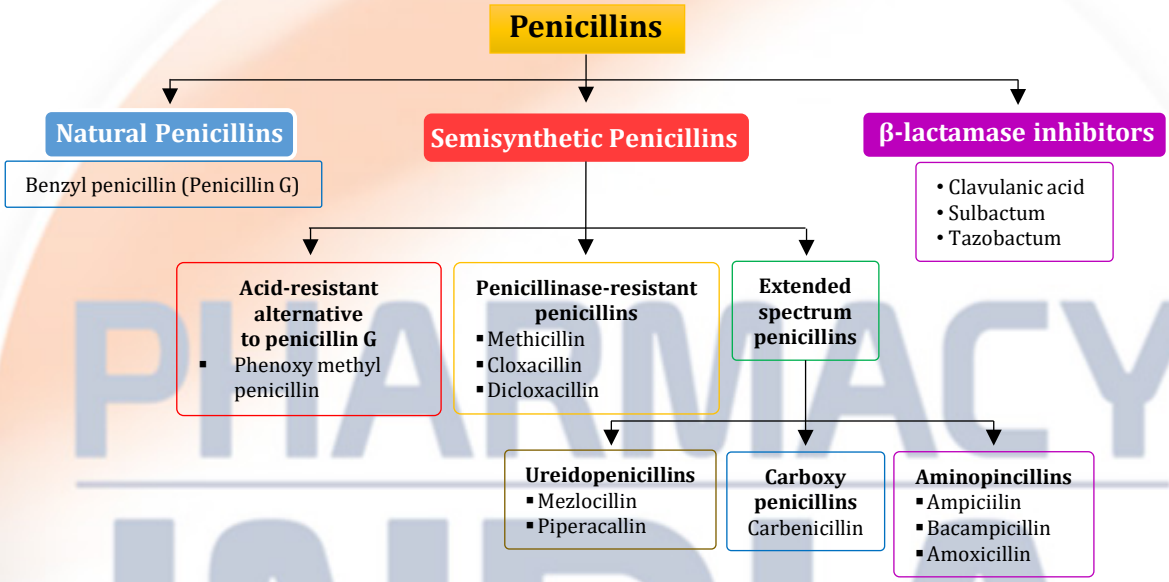
10. Acid Labile penicillin is

(a) Cloxacillin (b) Flucloxacillin

(c) Methicillin (d) Phenoxy Methyl penicillin

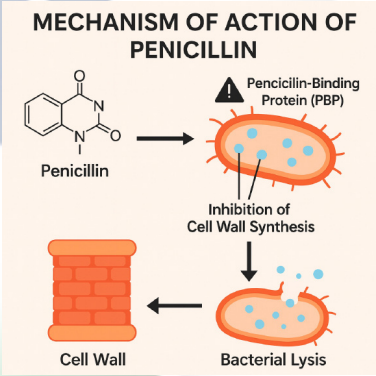
Beta-Lactam Antibiotics

- **Penicillin** G (Benzylpenicillin) is acid labile, hence destroyed by gastric acid.
- Probenecid inhibits tubular secretion of penicillins.
- Excreted by 10% via **glomerular filtration** & 90% via **active tubular secretion** in the proximal tubule.
- **Penicillin** binds to albumin.
- **Penicillins** are strong monobasic acids.



☐ USES & ADVERSE EFFECTS OF PENICILLINS

Adverse effects	Uses (DSSSB 2019)
• Allergic Reactions • Jarisch-Herxheimer reactions • Diarrhea • CNS irritation (seizures) • Acute Interstitial Nephritis • Platelet dysfunction	• Penicillin G: It is the drug of choice for syphilis. Staphylococcus aureus infections. • Enterococci, listeria and haemophilus organisms. • Ampicillin is drug of choice for listeria meningitis (cephalosporins are not effective) and UTI caused by E. faecalis.



EXAM PUNCH

- Primaquine, Dapsone & Methylene Blue **cause hemolysis in a patient with glucose-6 PD deficiency.**
- Methicillin is mainly employed against staphylococci resistant to penicillin.
- **Penicillin** possesses the beta lactam ring.
- In the presence of food - absorption of ampicillin **reduces.**
- Decomposition of Penicillin and Sulpha drugs are accelerated by addition of a following compound known as **vanillin.**
- Ampicillin is degraded by the process of hydrolysis.
- The therapeutic advantage that Penicillin V has over Penicillin G is more reliable oral absorption.
- The antibiotic of choice in patients sensitive to Penicillin is erythromycin.
- Benzathine Penicillin is molecular composition of Benzyl Penicillin N, N dibenzyl ethylene diamine.
- **Sulbactam** is a beta-lactamase inhibitor.
- ß-lactamase resistant Penicillin is **nafcillin.**
- Co-amoxiclav is combination of **clavulanic acid and amoxicillin** - inhibit ß-lactamase enzymes and **prevent drug resistance.**

CEPHALOSPORINS

1st Generations	2ndGeneration	3rdGeneration	4thGeneration
Spectrum:			
Broad spectrum& Active mainly against gram positive organisms	Broad spectrum. Similar to 1stgeneration but less active on Gram +ve & more on Gram –ve	Broad spectrum similar to 2ndgeneration but less on Gram +ve &more on Gram -ve.	Similar to 3rdgeneration but more resistant to-β-lactamase enzyme.
Passage across BBB:			
Do not cross BBB →NOT effective in meningitis	Do not pass BBB except Cefuroxime.	Passes BBB → useful in meningitis	Passes BBB→useful in meningitis
Preparations:			
Oral: Cefaclor (Bacticlor) Cefprozil (Cefzil) Cefuroxime (Zinnat) Cephalexin Parenteral: Cefuroxime (Zinnat) Cefamandole Cefoxitin	**Oral:** Cefaclor (Bacticlor) Cefprozil (Cefzil) Cefuroxime (Zinnat) Loracrbef (lorabid) Parenteral: Cefuroxime (Zinnat) Cefamandole Cefoxitin	**Oral:** Cefixime, Cefpodoxime, Ceftibuten Parenteral: Cefotaxime (Claforan), Ceftriaxone(Rocephin), Cefoperazone(Cefobid), Ceftazidime (Fortum), Moxalactam	**Parenteral:** Cefepime , Cefpirome

☐ CEPHALOSPORIN SIDE EFFECTS, MECHANISM OF ACTION AND THEIR USES

Side effects	Mechanism of action	Uses
• Hypersensitivity reactions • Hypoprothrombinemia (bleeding) • Neutropenia • Nephrotoxicity • Diarrhoea • Disulfiram-like interaction	Inhibition of bacterial cell wall synthesis	• Infections resistant to Penicillin e.g. staphylococci & gonorrhea (Ceftriaxone is thedrug of choice). • Anaerobic infection • Respiratory tract infection • Urinary tract infections specially Gram -ve. • Meningitis: Cefuroxime, Cefotaxime & Ceftriaxone • Typhoid fever: (Ceftriaxone & Cefperazone).

☐ MONOBACTAM AND CARBAPENEMS

Class	Drug	Description
Monobactams	**Aztreonam** (Azactam)	100% bioavailabity after IM. Depends on renal excretion. 3-It is β-Lactamase resistant & Narrow spectrum (Affects mainly **Gram -ve** bacteria including P.aeruginosa & not effective against **Gram + ve** or anaerobes).
Carbapenems	**Imipenem**	Wide spectrum: Gram +ve, Gram -ve and anaerobes. Used IV in serious mixed aerobic & anerobic infections. Inactivated by renal tubular dipeptidase enzyme →Nephrotoxic metabolite. So, it is not given alone, but in combination with Cilastatin, which is a dipeptidase enzyme inhibitor (Imipenem + Cilastatin = **Tienam)**
	Meropenem	Similar to imipenem but not metabolized by dipeptidase enzyme. Less side effects & less liable to produce seizures.
	Ertapenem	Similar to Meropenem, but has longer half-life, So, given parenterally **once daily.**

☐ INHIBITORS OF CYTOPLASMIC MEMBRANE

Drugs	Description
Polymixin B	• ↓Cytoplasmic membrane function → leakage of cell contents→ bactericidal • Affects mainly Gram -ve organisms esp. pseudomonus • Not absorbed orally & nephrotoxic, so used ONLY locally
Daptomycin	• It affects cell membrane permeability. Used IV in vancomycin resistant infections (VRSA).
Polypeptide antibiotics	• Bacitracin (effective against Gram +ve) • Polymixins (effective against Gram -ve) • They are bactericidal & highly nephrotoxic, so, used locally only.

☐ MACROLIDE ANTIBIOTICS (TRICK – RACE S)

(Erythromycin – Clarithromycin – Azithromycin – Roxithromycin – Spiramycin)

Drug	Mechanism of action	Uses	Adverse effects
Erythromycin	They bind to 50 S ribosomal subunits →↓ Translocation →↓Protein synthesis.	Corynebactrial diphtheria - Chlamydial infection Mycoplasma - Legionella & Bordetella pertussis. Chlamydial infection of urogenital tract during pregnancy	Epigastric pain Diarrhea (most common) Cholestatic jaundice Hypersensitivity reaction & skin rash

☐ CLINDAMYCIN (DALACIN-C)- Analogue of lincon in

Mechanism of action	Uses	Adverse Effects
Similar to Erythromycin	Bone &Teeth infections. Intra-abdominal Anaerobic infections Locally in acne vulgaris	**Colitis:** Fatal pseudomembranous colitis (C. difficile) **Liver** function imparement **Intestinal** disturbances **Allergy** & skin rash

EXAM PUNCH

- Bactericidal in nature.
- **Cefepime** are the fourth generation Cephalosporins used mainly in serious infections including septicemia, respiratory tract infections and infections acquired from hospitals.
- Cephalosporine effective against pseudomonas aeruginosa is **cefoperazone.**
- Bactericidal action of Cephalosporin is due to **inhibition synthesis of bacterial cell wall.**