

## Procaine and Benzathine Penicillin

Penicillin G, also known as benzylpenicillin, is a natural penicillin widely used for its bactericidal activity. Due to its rapid clearance and acid instability, penicillin G is administered parenterally, often in depot forms to prolong its action. Two important depot formulations of penicillin G are **Procaine Penicillin** and **Benzathine Penicillin** .

### 1. Procaine Penicillin

#### Composition

- Combination of **one mole of procaine** (a local anesthetic) with **one mole of benzylpenicillin** .
- Procaine serves to reduce pain on injection and delays absorption of penicillin, providing a prolonged effect.

#### Pharmacokinetics

- Administered via intramuscular injection.
- Slowly absorbed from the muscle over several hours.
- Procaine is hydrolyzed by plasma esterases into non-toxic metabolites: para-aminobenzoic acid (PABA) and dimethylaminoethanol.
- Prolonged duration of penicillin G action for approximately **12 to 24 hours** .
- Provides higher peak plasma penicillin levels compared to benzathine penicillin but shorter duration.

#### Clinical Uses

- Treatment of infections caused by penicillin-sensitive bacteria such as:
  - Septicemia
  - Pneumonia
  - Endocarditis
  - Empyema
  - Pericarditis
- Commonly used for once-daily dosing via intramuscular injection (gluteal or mid-lateral thigh sites).

### 2. Benzathine Penicillin

#### Composition

- Combination of **one mole of benzathine (an ammonium salt)** with **two moles of benzylpenicillin** .
- Benzathine is poorly soluble, resulting in very slow absorption.

## Pharmacokinetics

- Administered via intramuscular injection.
- Very slow absorption with low but sustained plasma penicillin concentrations.
- Duration of action lasts **2 to 4 weeks** .
- Due to low solubility, serum levels remain low but prolonged.
- Insufficient cerebrospinal fluid (CSF) penetration — **not suitable for neurosyphilis treatment** .

## Clinical Uses

- Long-acting treatment for infections requiring prolonged low-level penicillin exposure such as:
  - Syphilis (early and latent stages)
  - Rheumatic fever prophylaxis
  - Yaws
  - Eradication of group A beta-hemolytic streptococci (prevention of post-streptococcal complications)
  - Some upper respiratory tract infections caused by streptococci

## 3. Key Differences Between Procaine and Benzathine Penicillin

Feature	Procaine Penicillin	Benzathine Penicillin
Duration of action	~12–24 hours	2–4 weeks
Peak plasma levels	Higher	Lower, sustained
Solubility	More soluble	Poorly soluble (insoluble)
Onset of action	Faster	Slower
Use	Acute bacterial infections requiring higher plasma levels	Long-term prophylaxis, chronic infections needing prolonged therapy
Pain on injection	Reduced due to procaine anesthetic	May be painful due to low solubility and depot effect

NB:

- **Administration:** Both formulations are only given via **intramuscular injection** ; intravenous use of depot forms is contraindicated.
- **Probenecid interaction:** Co-administration of probenecid reduces renal tubular secretion of penicillin, increasing and prolonging serum penicillin levels.
- **Rapid IV injection caution:** Rapid intravenous injection of penicillin G (not depot forms) can cause cardiac arrhythmias due to potassium content and high plasma levels.
- **Depot effect:** Both procaine and benzathine penicillins provide incomplete but prolonged release of penicillin into circulation.
- **Patient monitoring:** Especially important in patients with renal impairment or cardiac conditions.