REVIEW ARTICLE

Role of Beta-Lactam Antibiotics in Periodontal Disease

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ABSTRACT

Beta-lactam antibiotics are one of the most commonly prescribed drug classes with numerous clinical indications. From a biochemical point of view, these drugs have a common feature, which is the 3-carbon and 1-nitrogen ring (beta-lactam ring) that is highly reactive.

Keywords: Beta-lactam, Loading dose, Penicillin.

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INTRODUCTION

The discovery of Penicillin by Sir Alexander Fleming in 1928 remains part of medicine folklore

- First antibiotic used in humans, derived from a mold – Penicillium notatum
- Nucleus – thiazolidine and beta-lactam rings to which side chains are attached through an amide linkage.[1]

Classification of Penicillins

Natural penicillin

- Penicillin G (benzyl penicillin)
- Procaine penicillin G
- Benzathine penicillin G.

Acid-resistant penicillin

- Phenoxymethylpenicillin (penicillin V)
- Phenoxyethylpenicillin (phenethecillin).

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Penicillianse-resistant penicillins

- Acid labile – methicillin, nafcillin, cloxacillin, and dicloxacillin
- Acid resistant – flucloxacillin.

Penicillins effective against Gram-positive and some Gram-negative organisms

- Ampicillin
- Amoxicillin
- Talampicillin.

Extended-spectrum penicillins

- Carboxypenicillins – carbenicillin and ticarcillin
- Ureidopenicillins – piperacillin and mezlocillin
- Amidino penicillins – mecillinam and pivmecillinam.

Penicillins with beta-lactamase inhibitors

- Amoxicillin – clavulanic acid (Augmentin).[1]

MECHANISM OF ACTION

- Beta-lactam antibiotics – bactericidal, inhibits cell wall synthesis
- Inhibit transpeptidases – cross-linking does not take place
- Enzymes + related proteins – PBP.[2]

PREPARATION AND DOSAGE

1. PnG injection 0.5–5 MU IM or I.V 6–12 h – Dry powder in vials to be dissolved in sterile water
2. Procaine penicillin injection 0.5–1 MU 12–24 hourly as aqueous solution
3. Benzathine penicillin G 0.6–2.4 MU IM every 2–4 weeks as aqueous suspension (remains effective for prophylaxis for 4 weeks).[1]

Pharmacokinetics

- Orally and parenterally
- Benzyl penicillin – injection since not stable in acidic environment of stomach
- Dose varies according to body weight and severity of infection – usually – 2.4–4.8 g daily in four divided doses
- Oral penicillins – absorbed from GIT

- Amoxicillin – most readily absorbed and absorption not affected by food
- Widely distributed in the body – low levels in saliva and GCF (periodontal medicine)
- Does not enter mammalian cells or cross BBB, unless meninges are inflamed (periodontal medicine)
- Partially bound to plasma proteins (46–58% bound)
- Rapidly eliminated from plasma by kidneys
  GF = 10% Tubular secretion – 90%
- Excreted in breast milk in low conc.
- Found in cord blood and amniotic fluid (periodontal medicine)
- Plasma t1/2 of PnG – 30 min
- Neonates – longer attains adult values at 3 months (Tripathi)[2]

ANTIMICROBIAL SPECTRUM

Sensitive

- Gram-positive bacilli
- *Corynebacterium diphtheria*
- Spirochetes
- Clostridia.

Resistant

- *Bacteroides fragilis*
- *Chlamydiae*
- *Mycobacterium tuberculosis*
- Fungi
- Viruses.

USE OF PENICILLIN IN TREATMENT OF PERIODONTAL ABSCESS

Antibiotic Regimens for Adult Patients in the Treatment of Periodontal Abscess

- Amoxicillin loading dose of 1 g followed by maintenance dose of 500 mg TDS for 3 days
- With allergy to beta-lactam drugs
- Azithromycin dose of 1 g on day 1 followed by 500 mg BD for days 2 and 3 or
- Clindamycin dose of 600 mg on day 1 followed by 300 mg QID for 3 days.

Use of Penicillin in Treatment of Adult Refractory Periodontitis

The first report from this ongoing study described the results of treatment in 10 patients with adult periodontitis who had not responded to surgery and the adjunctive use of tetracyclines.

- If the subgingival microbiota was susceptible to Au, patients were treated with 1 Au "250" tablet 3 times a day for 14 days and were scaled and root planed with local anesthesia.

Active disease sites which had lost an average of over 2 mm of attachment "regained" virtually all the loss and remained stable for 12 months.[3]

Use of Penicillin in Treatment of LJP

The resistance demonstrated by many isolates of *Aggregatibacter actinomycetemcomitans* to the penicillin including Au makes these antibiotics poor choices in the treatment of *A. actinomycetemcomitans*-associated periodontal disease.

- For patients who cannot tolerate tetracyclines or who harbor a flora consisting of tetracycline-resistant *A. actinomycetemcomitans* an alternate regimen, consisting of a combination of metronidazole and amoxicillin or Au, may be effective at eliminating this organism.
- Ampicillin[3]
  - Active against all organisms sensitive to penicillin
  - Not degraded by gastric acid, oral absorption – incomplete
  - Food interferes with absorption
  - Excretion – kidney, (tubular secretion)
  - Plasma t1/2–1 h

Dose: 0.5–2 g oral/IM or IV depending on severity of infection every 6 h.

Children: 25–50 mg/kg/day.

Cloxacillin

- Has an isoxazolyl side chain
- Penicillinase and acid resistant
- Less active against PnG sensitive organisms
- Incompletely but dependably absorbed from oral route if taken empty stomach
- >90% plasma protein bound
- Plasma t1/2–1 h.

Dose: 0.25–0.5 g orally every 6 h for severe infection.

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