Doxycycline: Uses, MOA, Dose, Interactions and Side effects

Doxycycline is a tetracycline antibiotic active against susceptible gram-negative and gram-positive microorganisms. It is a broad and medium-spectrum antibiotic. Other important members of the tetracycline class include tetracycline and oxytetracycline. The drug is bacteriostatic and has more activity overall than tetracycline HCl. It is especially useful in prostatitis due to high levels in prostatic fluid.

Indications
Doxycycline is indicated for infectious diseases caused by susceptible gram-positive and gram-negative organisms, including:

- **Enterobacter aerogenes** , **Shigella species** , **Acinetobacter species**
- **Skin infections** : acne vulgaris
- **Ophthalmic infections** : trachoma, staphylococci, gonococci
- **UTIs** : Klebsiella, Escherichia coli
- **Rickettsial infections** : Rocky Mountain spotted fever, epidemic typhus, scrub typhus, Q fever
- **Epididymoorchitis** : C. trachomatis
- **Murine typhus** , **Lymphogranuloma venereum** , **Psittacosis** , **Tularemia**
- **Brucellosis** (with streptomycin)
- **STIs** : gonorrhea, syphilis, yaws (penicillin allergy)
- **Anthrax** , **Listeriosis** (Listeria monocytogenes)
- **Respiratory tract infections** , **Acute bacterial rhinosinusitis**
- **Periodontal disease** , **Rosacea (inflammatory lesions)**
- **Chlamydia trachomatis**
- **Malaria prophylaxis** : Plasmodium falciparum (resistant strains)
- **Intestinal amebiasis** , **Infective endocarditis**
- **Purulent cellulitis** : community-acquired MRSA

Mechanism of Action
Doxycycline is bacteriostatic. It is more lipophilic than other tetracyclines and penetrates bacterial lipid bilayers more easily. It binds reversibly to the 30S subunit of bacterial ribosomes, blocking aminoacyl-tRNA binding to mRNA, inhibiting protein synthesis. It may also block dissociation of peptidyl tRNA from ribosomes, arresting protein synthesis.

Dosage and Administration

- **Acne** : 100 mg/day initially, reduced to 50 mg/day
- **Children (8–12 years)** : 200 mg day 1, then 100 mg/day (200 mg/day for severe infections)
- **Acne vulgaris** : 50 mg/day for 6–12 weeks
- **STIs** : 100 mg twice daily for 7 days
- **Chloroquine-resistant malaria** : 200 mg/day for 7 days
- **Malaria prophylaxis** : 100 mg/day, start 1–2 days before travel and continue 4 weeks after

- **Scrub typhus** : 200 mg single dose (STAT)
- **Leptospirosis prevention** : 200 mg weekly
- **Rocky Mountain fever** : 100 mg twice/day for at least 7 days

Administration Notes

- Take after food; avoid food immediately before/after
- Do not chew tablets; drink plenty of fluids to avoid esophageal irritation
- Avoid taking at bedtime due to risk of esophageal ulceration
- IV: Administer slowly over 1–2 hours
- Continue for 24–48 hours after symptom resolution

Pharmacokinetics

- **Absorption** : Almost complete orally
- **Peak Serum Time** : 1.5–4 hours
- **Bioavailability** : Reduced at high pH
- **Protein Binding** : ~90%
- **Metabolism** : Hepatic
- **Half-life** : 15–25 hours
- **Excretion** : Urine and feces

Side Effects and Precautions

- **Common** : GI upset (nausea, diarrhea), candidiasis, thrush
- **Suprainfections** : Candida, resistant coliforms, resistant staph enteritis (rare)
- **Hypersensitivity** : Rash, exfoliative dermatitis, Stevens-Johnson syndrome, urticaria, angioedema, anaphylaxis, pericarditis
- **Teeth and Bone Effects** : Discoloration and growth inhibition in fetus/children
- **Phototoxicity**

Contraindications

- Pregnancy (especially after 2nd month)
- Children <12 years
- Breastfeeding
- Concurrent use of antacids or supplements with Ca2+, Mg2+, Al3+, Fe2+/3+
- Use with hepatotoxic drugs

Special Notes

- Chelates with Ca2+, Mg2+, Fe3+ ? reduced absorption and efficacy
- Avoid milk, antacids, or iron-containing foods/supplements

Drug Interactions

- **Reduced Absorption** : Antacids (Al, Mg, Ca), iron salts, laxatives (Mg), cholestyramine, colestipol
- **Increased Clearance** : Barbiturates, carbamazepine, phenytoin

- **Increased Digoxin Levels** : Risk of toxicity
- **Isotretinoin** : ? risk of intracranial hypertension
- **Oral Anticoagulants** : ? hypoprothrombinemic effect
- **Oral Contraceptives** : ? efficacy, ? breakthrough bleeding
- **Penicillin** : ? bactericidal action
- **Pentane** : ? risk of fatal renal toxicity
- **Sodium Bicarbonate** : Alters absorption via pH shift