Pharmacology of Anthelmintic Drugs

Introduction

- Anthelmintic drugs are agents used to treat infections caused by helminths (worms), which include nematodes (roundworms), cestodes (tapeworms), and trematodes (flukes).
- These parasitic infestations are highly prevalent in tropical and developing regions and are often associated with poor sanitation and hygiene.
- **Anthelmintics work by:**
  - Paralyzing the worms
  - Damaging their cuticle
  - Interfering with metabolism or reproduction
  - Promoting expulsion from the host
- Effective therapy depends on the type of worm, location, and life cycle stage targeted.

Classification of Anthelmintic Drugs

Based on Type of Helminth Treated

1. Anti-Nematodal Drugs (Roundworms)

- Albendazole, Mebendazole
- Pyrantel pamoate
- Levamisole
- Ivermectin
- Diethylcarbamazine (DEC)

2. Anti-Cestodal Drugs (Tapeworms)

- Praziquantel
- Albendazole
- Niclosamide

3. Anti-Trematodal Drugs (Flukes)

- Praziquantel
- Triclabendazole
- Bithionol (rare)

Mechanism of Action

Drug	Mechanism
Albendazole/Mebendazole	Inhibit microtubule synthesis in parasite → ↓ glucose uptake → energy depletion

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Pyrantel pamoate	Depolarizing neuromuscular blocker → spastic paralysis of worm
Levamisole	Nicotinic agonist at ganglia → sustained contraction → expulsion
Ivermectin	Stimulates GABA release → paralysis (especially in filaria)
Diethylcarbamazine	Alters parasite surface → enhanced host immune attack
Praziquantel	Increases Ca^{2+} permeability → muscular contraction, tegument damage
Niclosamide	Inhibits oxidative phosphorylation in tapeworm mitochondria

Pharmacokinetics (ADME)

Drug	Absorption	Distribution	Metabolism	Excretion	Notes
Albendazole	Poor (↑ with fat)	Wide, CNS penetration	Hepatic → sulfoxide	Bile, urine	Active metabolite effective
Mebendazole	Poor	Limited	Hepatic	Fecal	Minimal systemic effect
Pyrantel pamoate	Poor	GI tract (local)	Minimal	Feces	Acts locally in the gut
Levamisole	Good oral	Wide	Hepatic	Urine	T½ ~4 hours
Ivermectin	Good oral	Lipophilic tissues	Hepatic (CYP3A4)	Feces	Does not cross BBB
DEC	Good oral	Wide	Hepatic	Urine	T½ ~8–12 hours
Praziquantel	Good oral	Wide, CNS	Hepatic (CYP3A4)	Urine	T½ ~1.5 hours
Niclosamide	Minimal absorption	Acts in GI lumen	Minimal	Feces	Used for luminal tapeworms

Pharmacodynamics

- **Albendazole/Mebendazole**: Broad-spectrum, slow-acting; depletes glycogen stores
- **Pyrantel/Levamisole**: Rapid action; paralyze worms for expulsion
- **Ivermectin/DEC**: Effective against filarial worms and ectoparasites

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- **Praziquantel**: Cestodes and trematodes; rapid contraction and death
- **Niclosamide**: Tapeworms; kills scolex and segments, avoids systemic effects

Therapeutic Uses

Drug	Indications
Albendazole	Ascariasis, hookworm, pinworm, strongyloidiasis, hydatid cysts, neurocysticercosis
Mebendazole	Same as albendazole (less used now)
Pyrantel pamoate	Enterobiasis, ascariasis, hookworm
Levamisole	Ascariasis (now obsolete); immunomodulator in colon cancer (adjunct)
Ivermectin	Onchocerciasis, strongyloidiasis, lymphatic filariasis, scabies
Diethylcarbamazine	Filariasis (Wuchereria, Brugia), tropical eosinophilia
Praziquantel	Schistosomiasis, neurocysticercosis, taeniasis, clonorchiasis
Niclosamide	Taenia saginata, Taenia solium (tapeworms)

Adverse Effects

Drug	Major Adverse Effects
Albendazole	Mild GI upset, dizziness, long-term use: hepatotoxicity, leukopenia
Mebendazole	Similar to albendazole; rare hypersensitivity reactions
Pyrantel	Nausea, headache, rash; minimal systemic toxicity
Levamisole	Nausea, rash, **agranulocytosis**, CNS effects
Ivermectin	Mazzotti reaction (in onchocerciasis): fever, hypotension
DEC	Headache, fever, allergic-type reactions (from dying worms)
Praziquantel	Abdominal pain, dizziness, headache; increased intracranial pressure (neurocysticercosis)
Niclosamide	GI upset, mild; safe due to minimal absorption

Contraindications

Drug	Contraindications
Albendazole	Pregnancy (especially 1st trimester), liver disease
Mebendazole	Same as albendazole

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Pyrantel	Liver disease (caution), children <2 years (relative)
Levamisole	Bone marrow suppression, epilepsy
Ivermectin	Meningitis, pregnancy (relative), <15 kg children
DEC	Onchocerciasis (worsens reactions), renal disease
Praziquantel	Ocular cysticercosis (inflammation risk)
Niclosamide	None significant; not recommended in children <2 years

Drug Interactions

Drug	Interactions
Albendazole	↑ levels with **fatty meals**, **cimetidine**
Praziquantel	↑ levels with cimetidine; ↓ with phenytoin, carbamazepine
Ivermectin	CYP3A4 interactions; avoid with other GABA agonists
DEC	Additive reactions with corticosteroids (used to control Mazzotti reaction)
Levamisole	Additive bone marrow suppression with other cytotoxics
Niclosamide	None significant

Dose and Route of Administration

Drug	Dose Example (Adult)	Route
Albendazole	400 mg once (nematodes); 15 mg/kg/day (hydatid cysts)	Oral
Mebendazole	100 mg BID × 3 days or 500 mg once	Oral
Pyrantel pamoate	10 mg/kg (max 1 g) single dose	Oral
Levamisole	150 mg single dose (rarely used)	Oral
Ivermectin	150–200 mcg/kg single dose; repeated as needed	Oral
DEC	6 mg/kg/day in 3 divided doses × 12 days	Oral
Praziquantel	15–25 mg/kg 3 times a day × 1 day	Oral
Niclosamide	2 g single dose (adult)	Oral

Note: Albendazole and Praziquantel are best taken with fatty meals for enhanced absorption.

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