The following table lists the major parasitic infections, causative organisms and drugs of choice for treatment. For investigational antiparasitic agents available from the Centers for Disease Control, refer to the CDC Anti-Infective Agents monograph.

Major Parasite Infections

	Infection (common name)	Organism	Drug(s) of Choice
Intestinal Nematodes	Ascariasis[1] (Roundworm)	*Ascaris lumbricoides*	Mebendazole, Pyrantel pamoate or Diethylcarbamazine
	Uncinariasis (Hookworm)	*Ancylostoma duodenale* *Necator americanus*	Mebendazole or Pyrantel pamoate[2]
	Strongyloidiasis (Threadworm)	*Strongyloides stercoralis*	Thiabendazole
	Trichuriasis (Whipworm)	*Trichuris trichiura*	Mebendazole
	Enterobiasis[3] (Pinworm)	*Enterobius vermicularis*	Mebendazole, Pyrantel pamoate or Albendazole
	Capillariasis	*Capillaria philippinensis*	Mebendazole, Thiabendazole or Albendazole
Tissue Nematodes	Trichinosis	*Trichinella spiralis*	Steroids for severe symptoms plus Thiabendazole, Albendazole, Flubendazole[6] or Mebendazole[2]
	Cutaneous larva migrans (Creeping eruption)	*Ancylostoma braziliense* and others	Thiabendazole, Albendazole or Ivermectin[4]
	Onchocerciasis (River blindness)	*Onchocerca volvulus*	Suramin[5], Diethylcarbamazine or Ivermectin[4]
	Dracontiasis (Guinea worm)	*Dracunculus medinensis*	Thiabendazole or Mebendazole
	Angiostrongyliasis (Rat lungworm)	*Angiostrongylus cantonensis*	Thiabendazole or Mebendazole
	Loiasis	*Loa loa*	Diethylcarbamazine
Cestodes	Taeniasis (Beef tapeworm)	*Taenia saginata*	Praziquantel[2] or Niclosamide[6]
	(Pork tapeworm)	*Taenia solium*	Praziquantel[2], Niclosamide[6] or Albendazole
	Diphyllobothriasis (Fish tapeworm)	*Diphyllobothrium latum*	Praziquantel[2] or Niclosamide[6]
	Dog tapeworm	*Dipylidium caninum*	Praziquantel[2]
	Hymenolepiasis (Dwarf tapeworm)	*Hymenolepis nana*	Praziquantel[2] or Niclosamide[6]
	Hydatid cysts	*Echinococcus granulosus*	Albendazole or Praziquantel
Trematodes	Schistosomiasis	*Schistosoma mansoni*	Praziquantel or Oxamniquine
		Schistosoma japonicum	Praziquantel
		Schistosoma haematobium	Praziquantel
		Schistosoma mekongi	Praziquantel
	Hermaphroditic Flukes		
	Fasciolopsiasis (Intestinal fluke)	*Fasciolopsis buski*	Praziquantel
		Heterophyes heterophyes *Metagonimus yokogawai*	Praziquantel
	Clonorchiasis (Chinese liver fluke)	*Clonorchis sinensis*	Praziquantel
	Fascioliasis (Sheep liver fluke)	*Fasciola hepatica*	Praziquantel or Bithionol[4]
	Opisthorchiasis (Liver fluke)	*Opisthorchis viverrini*	Praziquantel
	Paragonimiasis (Lung fluke)	*Paragonimus westermani*	Praziquantel or Bithionol[4] (alternate)

[1] Thiabendazole is also indicated in Ascariasis.
[2] Unlabeled use.
[3] Thiabendazole is also indicated in Enterobiasis.
[4] Available from the CDC.
[5] Available from the CDC, although generally not recommended.
[6] Not available in the US.

Benzimidazoles

MEBENDAZOLE

Rx	~~Vermox (Janssen)~~	**Tablets, chewable**: 100 mg	In 12s.
Rx	**Mebendazole** (Copley)		In 12s.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

➤*Helminths:* Treatment of *Trichuris trichiura* (whipworm), *Enterobius vermicularis* (pinworm), *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale* (common hookworm) or *Necator americanus* (American hookworm), in single or mixed infections.

Administration and Dosage

The same dosage schedule applies to children and adults.

Tablets may be chewed, swallowed or crushed and mixed with food. No special procedures, such as fasting or purging, are required.

If the patient is not cured 3 weeks after treatment, a second treatment course is advised.

➤*Trichuriasis, ascariasis and hookworm infection:* One tablet morning and evening on 3 consecutive days. In one study, treatment with a single 500 mg dose was effective against *A. lumbricoides*.

➤*Enterobiasis:* A single tablet given once.

Actions

➤*Pharmacology:* Mebendazole inhibits the formation of the ~~worms'~~ microtubules and irreversibly blocks glucose uptake by the susceptible helminths, thereby depleting endogenous glycogen stored within the parasite that is required for survival and reproduction of the helminth. Mebendazole does not affect blood glucose concentrations in the host.

➤*Pharmacokinetics:* Mebendazole is poorly absorbed (5% to 10%) after oral administration. Peak plasma levels are reached in 2 to 4 hours. Following administration of 100 mg of mebendazole twice daily for 3 consecutive days, plasma levels of mebendazole and its primary metabolite did not exceed 0.03 mcg/ml and 0.09 mcg/ml, respectively. Approximately 2% of the drug is excreted in the urine during the first 24 to 48 hours. Most of the dose is excreted in the feces as unchanged drug or primary metabolites.

➤*Microbiology:* Active against *Trichuris trichiura* (whipworm), *Enterobius vermicularis* (pinworm), *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale* (common hookworm) and *Necator americanus* (American hookworm). Parasite immobilization and death are slow, and complete clearance from the GI tract may take up to 3 days after treatment. Efficacy varies as a function of such factors as preexisting diarrhea and GI transit time, degree of infection and helminth strains.

Contraindications

Hypersensitivity to mebendazole.

Warnings

➤*Hydatid disease:* There is no evidence that mebendazole is effective for hydatid disease.

➤*Pregnancy: Category C.* Mebendazole was embryotoxic and teratogenic in pregnant rats at single oral doses as low as 10 mg/kg. This drug is not recommended for use in pregnant women. Based on a limited number of women, the incidence of spontaneous abortion, malformation and teratogenesis did not exceed that in the general population. During pregnancy, especially during the first trimester, use mebendazole only if the potential benefit justifies the potential risk to the fetus.

➤*Lactation:* It is not known whether mebendazole is excreted in breast milk. Because many drugs are excreted in breast milk, excercise caution when mebendazole is administered to a nursing woman.

➤*Children:* Safety and efficacy for use in children < 2 years of age have not been established; consider the relative benefit vs risk.

Drug Interactions

➤*Carbamazepine and hydantoins:* May reduce the plasma levels of concomitant mebendazole, possibly decreasing its therapeutic effect.

Adverse Reactions

➤*GI:* Transient abdominal pain and diarrhea have occurred in cases of massive infection and expulsion of worms.

➤*Hematologic:* Two patients receiving high doses of mebendazole for echinococcosis developed a severe but reversible neutropenia apparently because of marrow suppression.

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MEBENDAZOLE

➤*Miscellaneous:* Fever, a possible response to drug-induced tissue necrosis, has occurred.

Overdosage

GI complaints lasting up to a few hours may occur. Induce vomiting and purging. Refer to General Management of Acute Overdosage.

Patient Information

Chew or crush tablet and mix with food.

Parasite death may be slow. Removal from digestive tract may take up to 3 days after treatment. Effectiveness depends on factors such as degree of infection or resistance of parasite to treatment, presence of diarrhea and how quickly things pass through the digestive system. Laxative therapy and fasting are not necessary.

If not cured in 3 weeks, a second treatment is recommended.

➤*Pinworm infections:* These are easily spread to others. If one family member has a pinworm infection, treat all family members in close contact with the patient. This decreases the chance of spreading the infection.

Strict hygiene is essential to prevent reinfection. Disinfect toilet facilities daily. Change and launder undergarments, bed linens, towels and nightclothes daily.

THIABENDAZOLE

Rx	**Mintezol** (Merck)	**Tablets, chewable:** 500 mg	Lactose, saccharin. (MSD 907). White, scored. Orange flavor. In 36s.
		Oral Suspension: 500 mg/5 ml	Sorbic acid, sorbitol. In 120 ml.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

➤*Helminths:* Treatment of strongyloidiasis (threadworm infection), cutaneous larva migrans (creeping eruption) and visceral larva migrans.

Although not indicated as primary therapy, when enterobiasis (pinworm) occurs with any of the conditions listed above, additional therapy is not required for most patients. Use thiabendazole only in the following infestations when more specific therapy is not available or cannot be used or when further therapy with a second agent is desirable: Uncinariasis (hookworm: *Necator americanus* and *Ancylostoma duodenale*); Trichuriasis (whipworm); Ascariasis (large roundworm).

Also indicated for alleviating symptoms of trichinosis during the invasive phase.

Administration and Dosage

➤*< 150 lbs (68 kg):* 10 mg/lb/dose (22 mg/kg/dose).

➤*≥ 150 lbs:* 1.5 g/dose.

The usual dosage schedule for all conditions is 2 doses per day. Maximum daily dose is 3 g after meals if possible.

Dietary restriction, complementary medications and cleansing enemas are not needed.

Thiabendazole Dosage Regimen for Each Indication

Indication	Regimen	Comments
Strongyloidiasis[1] Ascariasis[1] Uncinariasis[1] Trichuriasis[1]	2 doses/day for 2 successive days	May also use single dose of 20 mg/lb (44 mg/kg) but with higher incidence of side effects.
Cutaneous larva migrans (creeping eruption)	2 doses/day for 2 successive days	If active lesions are still present 2 days after end of therapy, a second course is recommended.
Trichinosis[1]	2 doses/day for 2 to 4 successive days. Individualize dosage	Optimal dosage has not been established.
Visceral larva migrans	2 doses/day for 7 successive days	Safety and efficacy data on the 7 day treatment are limited.

[1] Clinical experience with thiabendazole in children weighing < 13.6 kg (30 lbs) is limited.

Actions

➤*Pharmacokinetics:* Thiabendazole is rapidly absorbed and peak plasma concentrations occur within 1 to 2 hours. It is metabolized almost completely and appears in the urine as conjugates. In 48 hours, ≈ 5% of the administered dose is recovered from feces and ≈ 90% from urine. Most is excreted within the first 24 hours.

➤*Microbiology:* Thiabendazole is vermicidal or vermifugal against *Enterobius vermicularis* (pinworm); *Ascaris lumbricoides* (roundworm); *Strongyloides stercoralis* (threadworm); *Necator americanus* and *Ancylostoma duodenale* (hookworm); *Trichuris trichiura* (whipworm); *Ancylostoma braziliense* (dog and cat hookworm); and *Toxocara canis* and *Toxocara cati* (ascarids).

Thiabendazole's effect on larvae of *Trichinella spiralis* that have migrated to muscle is questionable. It suppresses egg or larval production and may inhibit the subsequent development of those eggs or larvae which are passed in the feces. While the exact mechanism is unknown, the drug inhibits the helminth-specific enzyme fumarate reductase. The anthelmintic activity against *Trichuris trichiura* (whipworm) is least predictable.

Contraindications

Hypersensitivity to thiabendazole.

Warnings

➤*CNS effects:* Because CNS side effects may occur, avoid activities requiring mental alertness.

➤*Hypersensitivity reactions:* If hypersensitivity reactions occur, discontinue the drug immediately. Erythema multiforme has been associated with therapy; in severe cases (eg, Stevens-Johnson syndrome), fatalities have occurred. Refer to Management of Acute Hypersensitivity Reactions.

➤*Pregnancy: Category C.* There are no adequate and well controlled studies in pregnant women. Use during pregnancy only if the potential benefit outweighs the risk to the fetus.

➤*Lactation:* It is not known whether this drug is excreted in breast milk. Because of the potential for serious adverse reactions in nursing infants, decide whether to discontinue nursing or drug taking into account importance of drug to mother.

➤*Children:* Safety and efficacy for the treatment of Strongyloidiasis, Ascariasis, Uncinariasis, Trichuriasis and Trichinosis in children weighing < 13.6 kg (30 lbs) has been limited.

Precautions

➤*Monitoring:* Monitor patients with hepatic or renal dysfunction carefully.

➤*Supportive therapy:* This is indicated for anemic, dehydrated or malnourished patients prior to initiation of therapy.

➤*Metabolite:* Some patients may excrete a metabolite that imparts an odor to urine similar to that occurring after ingestion of asparagus.

➤*Thiabendazole:* It is not suitable for the treatment of mixed infections with ascaris because it may cause these worms to migrate. Use only in patients in whom susceptible worm infestation has been diagnosed; do not use prophylactically.

➤*Lab test interactions:* Rarely, a transient rise in cephalin flocculation and AST has occurred in patients receiving thiabendazole.

Drug Interactions

➤*Xanthines:* Thiabendazole may compete with these agents for sites of metabolism in the liver, thus elevating the serum levels of the xanthine to potentially toxic levels. Monitor xanthine serum levels and reduce the dose if necessary.

Adverse Reactions

➤*CNS:* Dizziness; weariness; drowsiness; giddiness; headache; numbness; hyperirritability; convulsions; collapse; psychic disturbances.

➤*GI:* Anorexia; nausea; vomiting; diarrhea; epigastric distress; jaundice; cholestasis; parenchymal liver damage.

➤*GU:* Hematuria; enuresis; malodor of the urine; crystalluria.

➤*Hypersensitivity:* Pruritus; fever; facial flush; chills; conjunctival injection ("red eye"); angioedema; anaphylaxis; skin rashes (including perianal); erythema multiforme (including Stevens-Johnson syndrome); lymphadenopathy. (See Warnings.)

➤*Special senses:* Tinnitus; abnormal sensation in eyes; xanthopsia (objects appear yellow); blurring of vision; drying of mucous membranes (eg, mouth, eyes).

➤*Miscellaneous:* Appearance of live Ascaris in the mouth and nose; hypotension; transient leukopenia; hyperglycemia.

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THIABENDAZOLE

Overdosage

➤*Symptoms:* Possible transient disturbances of vision and psychic alterations.

➤*Treatment:* There is no specific antidote. Use symptomatic and supportive measures. Induce emesis or carefully perform gastric lavage. Refer to General Management of Acute Overdosage.

Patient Information

May cause stomach upset. Take with food.

➤*Chewable tablets:* Chew thoroughly before swallowing.

Cleansing enemas are not needed after drug therapy.

Duration of therapy varies from 2 or more days depending upon the condition being treated.

Pinworm infections are easily spread to others. If one family member has a pinworm infection, treat all family members in close contact with the patient. This decreases the chance of spreading the infection.

Repeat therapy in 7 days to prevent reinfection.

Strict hygiene is essential to prevent reinfection. Disinfect toilet facilities daily. Change and launder undergarments, bed linens, towels and nightclothes daily.

May produce drowsiness or dizziness. Use caution when driving or performing other tasks requiring alertness.

ALBENDAZOLE

Rx **Albenza** (SmithKline Beecham) **Tablets:** 200 mg — Lactose, saccharin. Biconvex. In film-coated *Tiltab.* In 112s.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

➤*Neurocysticercosis:* For the treatment of parenchymal neurocysticercosis due to active lesions caused by larval forms of the pork tapeworm, *T. solium.*

➤*Hydatid disease:* For the treatment of cystic hydatid disease of the liver, lung and peritoneum caused by the larval form of the dog tapeworm, *E. granulosus.*

When medically feasible, surgery is considered the treatment of choice for hydatid disease. When administering albendazole in the pre- or post-surgical setting, optimal killing of cyst contents is achieved when three courses of therapy have been given.

Administration and Dosage

Dosing of Albendazole According to the Parasitic Infection

Indication	Weight	Dose	Duration
Hydatid disease	≥ 60 kg	400 mg twice a day with meals	28-day cycle followed by a 14-day albendazole-free interval, for a total of three cycles[1]
	< 60 kg	15 mg/kg/day given in divided doses twice a day with meals (maximum total daily dose 800 mg)	
Neurocysticercosis	≥ 60 kg	400 mg twice a day with meals	8 to 30 days
	< 60 kg	15 mg/kg/day given in divided doses twice a day with meals (maximum total daily dose 800 mg)	

[1] When administering albendazole in the pre- or post-surgical setting, optimal killing of cyst contents is achieved when three courses of therapy have been given.

Patients being treated for neurocysticercosis should receive appropriate steroid and anticonvulsant therapy as required. Consider oral or IV corticosteroids to prevent cerebral hypertensive episodes during the first week of treatment.

➤*Storage / Stability:* Store between 20° and 25°C (68° and 77°F).

Actions

➤*Pharmacology:* Albendazole's principal mode of action is its inhibitory effect on tubulin polymerization, which results in the loss of cytoplasmic microtubules.

➤*Pharmacokinetics:*

Absorption – Albendazole is poorly absorbed from the GI tract because of its low aqueous solubility. Albendazole concentrations are negligible or undetectable in plasma as it is rapidly converted to the sulfoxide metabolite prior to reaching the systemic circulation. The systemic anthelmintic activity has been attributed to the primary metabolite, albendazole sulfoxide. Oral bioavailability appears to be enhanced when albendazole is coadministered with a fatty meal (estimated fat content 40 g) as evidenced by higher (up to 5–fold on average) plasma concentrations of albendazole sulfoxide as compared with the fasted state.

Maximal plasma concentrations of albendazole sulfoxide are typically achieved 2 to 5 hours after dosing and are on average 1.31 mcg/ml (0.46 to 1.58 mcg/ml) following oral doses of albendazole (400 mg) when administered with a fatty meal. Plasma concentrations of albendazole sulfoxide increase in a dose-proportional manner over the therapeutic dose range following ingestion of a fatty meal (fat content 43.1 g). The mean apparent terminal elimination half-life of albendazole sulfoxide typically ranged from 8 to 12 hours in 25 healthy subjects, as well as in 14 hydatid and 8 neurocysticercosis patients.

Following 4 weeks of treatment with albendazole (200 mg three times daily), 12 patients' plasma concentrations of albendazole sulfoxide were ≈ 20% lower than those observed during the first half of the treatment period, suggesting that albendazole may induce its own metabolism.

Distribution – Albendazole sulfoxide is 70% bound to plasma protein and is widely distributed throughout the body; it has been detected in urine, bile, liver, cyst wall, cyst fluid and cerebral spinal fluid (CSF). Concentrations in plasma were 3– to 10–fold and 2– to 4–fold higher than those simultaneously determined in cyst fluid and CSF, respectively. Limited in vitro and clinical data suggest that albendazole sulfoxide may be eliminated from cysts at a slower rate than observed in plasma.

Metabolism / Excretion – Albendazole is rapidly converted in the liver to the primary metabolite, albendazole sulfoxide, which is further metabolized to albendazole sulfone and other primary oxidative metabolites that have been identified in human urine. Following oral administration, albendazole has not been detected in human urine. Urinary excretion of albendazole sulfoxide is a minor elimination pathway with < 1% of the dose recovered in the urine. Biliary elimination presumably accounts for a portion of the elimination as evidenced by biliary concentrations of albendazole sulfoxide similar to those achieved in plasma.

Special populations –

Renal function impairment: The pharmacokinetics of albendazole in patients with impaired renal function have not been studied. However, because renal elimination of albendazole and its primary metabolite, albendazole sulfoxide, is negligible, it is unlikely that clearance of these compounds would be altered in these patients.

Hepatic function impairment: In patients with evidence of extrahepatic obstruction, the systemic availability of albendazole sulfoxide is increased, as indicated by a 2–fold increase in maximum serum concentration and a 7–fold increase in area under the curve (AUC). The rate of absorption/conversion and elimination of albendazole sulfoxide appeared to be prolonged with mean T_{max} and serum elimination half-life values of 10 hours and 31.7 hours, respectively. Plasma concentrations of parent albendazole were measurable in only one of five patients.

Children: Albendazole sulfoxide pharmacokinetics were similar to those observed in fed adults.

Elderly: Although no studies have investigated the effect of age on albendazole sulfoxide pharmacokinetics, data in 26 hydatid cyst patients (up to 79 years) suggest pharmacokinetics similar to those in young healthy subjects.

➤*Microbiology:* Albendazole is active against the larval forms of *Echinococcus granulosus* and *Taenia solium.*

Contraindications

Hypersensitivity to the benzimidazole class of compound or any components of albendazole.

Warnings

➤*Hepatic function impairment:* Albendazole has been associated with mild to moderate elevations of hepatic enzymes in ≈ 16% of patients. These have returned to normal upon discontinuation of therapy. Perform liver function tests (transaminases) before the start of each treatment. If enzymes are significantly increased, discontinue albendazole therapy. Therapy can be reinstituted when liver enzymes have returned to pretreatment levels, but perform laboratory tests frequently during repeated therapy.

➤*Fertility impairment:* Patients should not become pregnant for at least 1 month following cessation of albendazole therapy.

➤*Elderly:* Experience in patients ≥ 65 years of age is limited. No problems associated with an older population have been observed.

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ALBENDAZOLE

➤*Pregnancy: Category C.* Albendazole has been shown to be teratogenic in animals. There are no adequate and well controlled studies of albendazole administration in pregnant women. Do not use albendazole in pregnant women except in clinical circumstances where no alternative management is appropriate. If a patient becomes pregnant while taking this drug, discontinue albendazole immediately.

➤*Lactation:* It is not known whether albendazole is excreted in breast milk. Because many drugs are excreted in breast milk, use caution when administering to a nursing woman.

➤*Children:* Experience in children < 6 years of age is limited. In hydatid disease, infection in infants and young children is uncommon, but no problems have been encountered in those who have been treated. In neurocysticercosis, infection is more frequently encountered. In studies involving pediatric patients as young as 1 year of age, no significant problems were encountered, and the efficacy appeared similar to the adult population.

Precautions

➤*Monitoring:*

White blood cell count – Albendazole has been shown to cause occasional (< 1% of treated patients) reversible reductions in total white blood cell count. Rarely, more significant reductions may be enountered including granulocytopenia, agranulocytosis or pancytopenia. Perform blood counts at the start of each 28–day treatment cycle and every 2 weeks during each 28–day cycle. Albendazole may be continued if the total white blood cell count decrease appears modest and does not progress.

➤*Coadministration:* Patients being treated for neurocysticercosis should receive appropriate steroid and anticonvulsant therapy as required. Consider oral or IV corticosteroids to prevent cerebral hypertensive episodes during the first week of anticysticeral therapy.

➤*Cysticercosis:* It may, in rare cases, involve the retina. Before initiating therapy for neurocysticercosis, examine the patient for the presence of retinal lesions. If such lesions are visualized, weigh the need for anticysticeral therapy against the possibility of retinal damage caused by albendazole-induced changes to the retinal lesion.

Drug Interactions

Albendazole Drug Interactions

Precipitant drug	Object drug*		Description
Dexamethasone	Albendazole	↑	Steady-state trough concentrations of albendazole sulfoxide were ≈ 56% higher when 8 mg dexamethasone was coadministered with each dose of albendazole (15 mg/kg/day) in eight neurocysticercosis patients.
Praziquantel	Albendazole	↑	Praziquantel (40 mg/kg) increased mean maximum plasma concentration and AUC of albendazole sulfoxide by ≈ 50% in healthy subjects.
Cimetidine	Albendazole	↑	Albendazole sulfoxide concentrations in bile and cystic fluid were increased (≈ 2-fold) in hydatid cyst patients treated with cimetidine.

* ↑ = Object drug increased.

Adverse Reactions

Adverse Reaction Incidence in Hydatid Disease and Neurocysticercosis (%)

Adverse reaction	Hydatid disease	Neurocysticercosis
Abnormal liver function tests	15.6	< 1
Abdominal pain	6	0
Nausea/Vomiting	3.7	6.2
Headache	1.3	11
Dizziness/Vertigo	1.2	< 1
Raised intracranial pressure	0	1.5
Meningeal signs	0	1
Reversible alopecia	1.6	< 1
Fever	1	0

The following adverse reactions were observed at an incidence of < 1%.

➤*Dermatologic:* Rash; urticaria.

➤*Hematologic:* Leukopenia (0.7%); granulocytopenia, pancytopenia, agranulocytosis, thrombocytopenia (rare).

➤*Hypersensitivity:* Allergic reactions.

➤*Renal:* Acute renal failure.

Overdosage

One case of overdosage has been reported with albendazole in a patient who took at least 16 g over 12 hours. No untoward effects were reported. In case of overdosage, symptomatic therapy (eg, gastric lavage and activated charcoal) and general supportive measures are recommended. Refer to General Management of Acute Overdosage.

Patient Information

Albendazole may cause fetal harm; therefore, begin treatment after a negative pregnancy test in women of childbearing age.

Caution women of childbearing age against becoming pregnant while on albendazole or within 1 month of completing treatment.

Take with food.

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DIETHYLCARBAMAZINE CITRATE

Rx	**Hetrazan**[1] (Wyeth-Ayerst)	**Tablets:** 50 mg	In 100s.

[1] Hetrazan is available from Wyeth-Ayerst Labs without charge for compassionate use only. For more information, physicians should contact: Wyeth-Ayerst Labs, P.O. Box 8299, Philadelphia, PA 19101; (610) 688-4400.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

Treatment of Bancroftian filariasis, onchocerciasis, ascariasis, tropical eosinophilia, loiasis.

Administration and Dosage

➤*Bancroft's filariasis, onchocerciasis and loiasis:* Usual dose is 2 mg/kg 3 times a day immediately following meals. When the disease is in the acute stage, continue treatment for 3 to 4 weeks. Recurrences have been more frequent with smaller doses. When, as a public health measure, it is desirable to treat large numbers of patients known to harbor microfilariae, use the same dosage schedule for 3 to 5 days. Laboratory tests in randomly selected patients are helpful in assessing efficacy of therapy.

➤*Ascariasis:*

Outpatients – 13 mg/kg, given once a day for 7 days, should reduce the number of worms by 85% to 100%. No pretreatment fasting or post-treatment purging is required. Expulsion of ascarids usually begins 1 or 2 days after therapy initiation.

Children – Give 6 to 10 mg/kg 3 times daily for 7 to 10 days. In particularly obstinate cases, an additional course consisting of 10 mg/kg 3 times daily is indicated.

➤*Tropical eosinophilia:* 13 mg/kg/day for 4 to 7 days.

Actions

➤*Pharmacology:* Diethylcarbamazine does not resemble other antiparasitic compounds. It is a synthetic organic compound which is highly specific for several common parasites and does not contain any toxic metallic elements.

The drug is effective against the following organisms: *Wuchereria bancrofti*, *Onchocerca volvulus*, *Loa loa* and *Ascaris lumbricoides*.

Diethylcarbamazine has demonstrated a low order of toxicity in animals.

Precautions

➤*Administration:* Administer carefully to avoid or to control allergic or other untoward reactions.

Adverse Reactions

➤*Wuchereria bancrofti*: Mild reactions are transient but fairly frequent. Headache, lassitude, weakness or general malaise are most common. Nausea, vomiting and skin rash occasionally occur. These effects are not considered serious and do not usually require discontinuation of therapy. However, it may be necessary to stop therapy when severe allergic phenomena appear in conjunction with skin rash. It has not yet been determined what proportion or type of reactions result from the death of the parasites rather than from the influence of the drug.

➤*Onchocerciasis:* Facial edema and pruritus, especially of the eyes, are often encountered. Severe reactions may develop after a single dose when intense infestations are treated. In such cases, only 1 dose should be given on the first day, 2 doses the second day and 3 daily thereafter for 30 days. If very severe reactions occur, discontinue the drug and start antihistamine therapy. After 1 or 2 days, therapy may be resumed, but if severe allergic phenomena again supervene, use the drug only with extreme caution.

➤*Ascariasis:* Giddiness, nausea, vomiting and malaise may occur more frequently following treatment of ascariasis in children who are malnourished or who suffer from various debilitating diseases.

PYRANTEL

~~otc~~	~~**Pin-Rid** (Apothecary)~~	**Capsules, soft gel:** 180 mg pyrantel pamoate (equiv. to 62.5 mg pyrantel base)	In 24s.
otc	**Reese's Pinworm** (Reese)		In 24s.
otc	**Antiminth** (Pfizer Labs)	**Oral Suspension:** 50 mg pyrantel (as pamoate) per ml	Sorbitol. Caramel-currant flavor. In 60 ml.
otc	**Pin-Rid** (Apothecary)	**Liquid:** 50 mg pyrantel (as pamoate) per ml	Sucrose, saccharin, parabens. Cherry flavor. In 30 ml.
otc	**Pin-X** (Effcon)		Sorbitol, parabens. Caramel flavor. In 30 ml.
otc	**Reese's Pinworm** (Reese)		In 30 ml.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

➤*Helminths:* Treatment of ascariasis (roundworm infection) and enterobiasis (pinworm infection).

Administration and Dosage

A single dose of 11 mg/kg (5 mg/lb). Maximum total dose is 1 g.

May be administered without regard to ingestion of food or time of day. Purging is not necessary. May be taken with milk or fruit juices.

Actions

➤*Pharmacology:* Pyrantel is a depolarizing neuromuscular blocking agent, resulting in spastic paralysis of the worm. It also inhibits cholinesterases. It is active against *Enterobius vermicularis* (pinworm) and *Ascaris lumbricoides* (roundworm); it is also effective against *Ancylostoma duodenale* (hookworm).

➤*Pharmacokinetics:* Pyrantel is poorly absorbed from the GI tract. Plasma levels of unchanged drug are low. Greater than 50% is excreted in feces as unchanged drug; ≤ 7% of the dose is found in the urine as parent drug and metabolites.

Contraindications

Hepatic disease; pregnancy (see Warnings); hypersensitivity to pyrantel.

Warnings

➤*Pregnancy:* Do not use during pregnancy unless otherwise directed by a physician.

➤*Children:* Safety and efficacy for use in children < 2 years have not been established.

Drug Interactions

➤*Piperazine:* In ascariasis, pyrantel and piperazine are mutually antagonistic; therefore, concomitant use is unwise.

➤*Theophylline:* Serum levels increased in a pediatric patient following pyrantel pamoate administration. Further study is needed.

Adverse Reactions

➤*CNS:* Headache; dizziness; drowsiness; insomnia.

➤*Dermatologic:* Rash.

➤*GI:* Anorexia; nausea; vomiting; abdominal cramps; diarrhea.

Patient Information

A single dose is required. The dose is based on body weight.

May be taken with food, milk, juice or on an empty stomach anytime during the day. Be certain to take the entire dose.

Using a laxative after taking the drug to facilitate removal of the parasites is not necessary.

➤*Pinworm infections:* These are easily spread to others. If one family member has a pinworm infection, treat all family members in close contact with the patient. This decreases the chance of spreading the infection.

Strict hygiene is essential to prevent reinfection. Disinfect toilet facilities daily. Change and launder undergarments, bed linens, towels and nightclothes daily.

A package insert is available for patients containing the following information: Symptoms of pinworm infestations; how to find and identify the pinworm; pinworm life cycle; how it is spread from person to person.

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PRAZIQUANTEL

Rx	**Biltricide** (Bayer)	**Tablets:** 600 mg	(Bayer LG). White to orange-tinged, oblong, tri-scored. Film-coated. In 6s.

Refer to the general discussion of these products in the Anthelmintics introduction.

Indications

For infections caused by the following: All species of schistosoma (eg, *Schistosoma mekongi, S. japonicum, S. mansoni,* and *S. hematobium*); liver flukes, *Clonorchis sinensis/Opisthorchis viverrini* (approval of this indication was based on studies in which the 2 species were not differentiated).

➤*Unlabeled uses:* Praziquantel has been used in the treatment of neurocysticercosis. It may also be beneficial in the treatment of other tissue flukes (eg, *Opisthorchis felineus, Paragonimus westermani,* and other species, toxemic schisto, Katayama fever), intestinal flukes (eg, *Heterophyes heterophyes, Fasciolopsis buski, Metagonimus yokogawai, Paragonimus westermani*), and intestinal cestodes (eg, *Diphyllobothrium latum, Taenia saginata* and *T. solium, Dipylidium caninum, Hymenolepis nana,* and *H. diminuta*).

Administration and Dosage

➤*Schistosomiasis:* 3 doses of 20 mg/kg as a 1 day treatment.

➤*Clonorchiasis and opisthorchiasis:* 3 doses of 25 mg/kg as a 1 day treatment.

The interval between the doses should not be < 4 and not > 6 hours.

Swallow the tablets unchewed with some liquid during meals. Keeping the tablets or the segments thereof in the mouth may reveal a bitter taste that can produce gagging or vomiting.

Segments are broken off by pressing the score (notch) with thumbnails. If ¼ of a tablet is required, this is best achieved by breaking the segment from the outer end.

Actions

➤*Pharmacology:* Praziquantel increases cell membrane permeability in susceptible worms, resulting in a loss of intracellular calcium, massive contractions, and paralysis of their musculature. The drug further results in vacuolization and disintegration of the schistosome tegument. This effect is followed by attachment of phagocytes to the parasite and death.

➤*Pharmacokinetics:* Praziquantel is rapidly absorbed (80%), reaching maximal serum concentration in 1 to 3 hours. CSF levels are ≈ 14% to 20% the total amount of drug in plasma. It undergoes significant first-pass biotransformation and the elimination half-life is 0.8 to 1.5 hours. Metabolites are excreted primarily in urine.

Contraindications

Previous hypersensitivity to praziquantel; ocular cysticercosis.

Warnings

➤*Ocular cysticercosis:* Because parasite destruction within the eyes may cause irreparable lesions, do not treat ocular cysticercosis with praziquantel.

➤*Pregnancy: Category B.* An increase in the abortion rate was found in rats at 3 times the single human therapeutic dose. There are no adequate and well-controlled studies in pregnant women. Use this drug during pregnancy only if clearly needed.

➤*Lactation:* Praziquantel appeared in breast milk at a concentration of ≈ 25% that of maternal serum. Do not nurse during treatment or the subsequent 72 hours.

➤*Children:* Safety in children < 4 years of age has not been established.

Precautions

➤*Hepatic effects:* Minimal increases in liver enzymes have occurred in some patients.

➤*Cerebral cysticercosis:* When schistosomiasis or fluke infection is found to be associated with cerebral cysticercosis, hospitalize the patient for the duration of treatment.

➤*Hazardous tasks:* May produce dizziness or drowsiness; observe caution while driving or performing other tasks requiring alertness on the day of and the day after treatment.

Drug Interactions

➤*H_2 antagonists:* Plasma concentrations of praziquantel may be elevated, increasing the effectiveness and risk of adverse reactions.

Adverse Reactions

In general, praziquantel is very well tolerated. Side effects are usually mild and transient and do not need treatment but may be more frequent or serious in patients with a heavy worm burden.

In order of severity: Malaise; headache; dizziness; abdominal discomfort (with or without nausea); rising temperature; urticaria (rare). Such symptoms can, however, also result from the infection itself. In patients with liver impairment caused by the infection, no adverse effects occurred that necessitated restriction in use.

Overdosage

In the event of overdose, give a fast-acting laxative.

Patient Information

Take with liquids during meals. Do not chew tablets.

May cause dizziness or drowsiness; observe caution while driving or performing other tasks requiring alertness.

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