THIOLA- tiopronin tablet, sugar coated
Mission Pharmacal Company

HIGHLIGHTS OF PRESCRIBING INFORMATION
These highlights do not include all the information needed to use THIOLA® safely and effectively. See full prescribing information for THIOLA.

THIOLA (tiopronin) tablets, for oral use
Initial U.S. Approval: 1988

INDICATIONS AND USAGE

THIOLA is a reducing and complexing thiol indicated, in combination with high fluid intake, alkali, and diet modification, for the prevention of cystine stone formation in adults and pediatric patients 20 kg and greater with severe homozygous cystinuria, who are not responsive to these measures alone. (1)

DOSAGE AND ADMINISTRATION

- The recommended initial dosage in adult patients is 800 mg/day. In clinical studies, the average dosage was about 1,000 mg/day. (2.1)
- The recommended initial dosage in pediatric patients 20 kg and greater is 15 mg/kg/day. Avoid dosages greater than 50 mg/kg per day in pediatric patients. (2.1, 5.1, 8.4)
- Administer THIOLA in 3 divided doses at the same times each day at least one hour before or 2 hours after meals. (2.1)
- Measure urinary cystine 1 month after initiation of THIOLA and every 3 months thereafter. (2.1)

DOSAGE FORMS AND STRENGTHS

Tablets: 100 mg (3)

CONTRAINDICATIONS

- Hypersensitivity to tiopronin or any component of THIOLA (4)

WARNINGS AND PRECAUTIONS

- Proteinuria, including nephrotic syndrome, and membranous nephropathy, has been reported with tiopronin use. Pediatric patients receiving greater than 50 mg/kg of tiopronin per day may be at increased risk for proteinuria. (2.1, 5.1, 8.4)
- Hypersensitivity reactions have been reported during tiopronin treatment. (4, 5.2)

ADVERSE REACTIONS

Most common adverse reactions (≥10%) are nausea, diarrhea or soft stools, oral ulcers, rash, fatigue, fever, arthralgia, proteinuria, and emesis. (6)

To report SUSPECTED ADVERSE REACTIONS, contact Mission Pharmacal Company at toll-free phone # 1-800-298-1087 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

USE IN SPECIFIC POPULATIONS

- Lactation: Breastfeeding is not recommended. (8.2)
- Geriatric: Choose dose carefully and monitor renal function in the elderly. (8.5)

See 17 for PATIENT COUNSELING INFORMATION.

Revised: 6/2019

FULL PRESCRIBING INFORMATION: CONTENTS*

* Sections or subsections omitted from the full prescribing information are not listed.

FULL PRESCRIBING INFORMATION

1 INDICATIONS AND USAGE

THIOLA is indicated, in combination with high fluid intake, alkali, and diet modification, for the prevention of cystine stone formation in adults and pediatric patients 20 kg and greater with severe homozygous cystinuria, who are not responsive to these measures alone.

2 DOSAGE AND ADMINISTRATION

2.1 Recommended Dosage

Adults: The recommended initial dosage in adult patients is 800 mg/day. In clinical studies, the average dosage was about 1,000 mg/day.

Pediatrics: The recommended initial dosage in pediatric patients weighing 20 kg and greater is 15 mg/kg/day. Avoid dosages greater than 50 mg/kg per day in pediatric patients *[see Warnings and Precautions (5.1), Use in Specific Populations (8.4)]*.

Administer THIOLA in 3 divided doses at the same times each day at least one hour before or 2 hours after meals.

Consider starting THIOLA at a lower dosage in patients with history of severe toxicity to d-penicillamine.

2.2 Monitoring

Measure urinary cystine 1 month after starting THIOLA and every 3 months thereafter. Adjust THIOLA dosage to maintain urinary cystine concentration less than 250 mg/L.

Assess for proteinuria before treatment and every 3 to 6 months during treatment *[see Warnings and*

Precautions (5.1)].

Discontinue THIOLA in patients who develop proteinuria, and monitor urinary protein and renal function. Consider restarting THIOLA treatment at a lower dosage after resolution of proteinuria.

3 DOSAGE FORMS AND STRENGTHS

Tablets for oral use:
100 mg tablets: round, white and imprinted in red with “M” on one side

4 CONTRAINDICATIONS

THIOLA is contraindicated in patients with hypersensitivity to tiopronin or any other components of THIOLA *[see Warnings and Precautions (5.2)]*.

5 WARNINGS AND PRECAUTIONS

5.1 Proteinuria

Proteinuria, including nephrotic syndrome, and membranous nephropathy, have been reported with tiopronin use. Pediatric patients receiving greater than 50 mg/kg of tiopronin per day may be at increased risk for proteinuria *[see Dosage and Administration (2.2), Adverse Reactions (6.1, 6.2) Use in Specific Populations (8.4)]*. Monitor patients for the development of proteinuria and discontinue therapy in patients who develop proteinuria *[see Dosage and Administration (2.2)]*.

5.2 Hypersensitivity Reactions

Hypersensitivity reactions (drug fever, rash, fever, arthralgia and lymphadenopathy) have been reported *[see Contraindications (4)]*.

6 ADVERSE REACTIONS

The following adverse reactions are discussed in greater detail in other sections of the labeling:

- Proteinuria *[see Warnings and Precautions (5.1)]*
- Hypersensitivity *[see Warnings and Precautions (5.2)]*

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, the adverse reaction rates observed in the clinical trials of the drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

Adverse reactions occurring at an incidence of ≥5% in an uncontrolled trial in 66 patients with cystinuria age 9 to 68 years are shown in the table below. Patients in group 1 had previously been treated with d-penicillamine; those in group 2 had not. Of those patients who had stopped taking d-penicillamine due to toxicity (34 out of 49 patients in group 1), 22 were able to continue treatment with THIOLA. In those without prior history of d-penicillamine treatment, 6% developed reactions of sufficient severity to require THIOLA withdrawal.

Table 1 presents adverse reactions ≥5% in either treatment group occurring in this trial.

Table 1:	**Adverse Reactions Occurring in One or More Patients**	
Adverse	**Group 1 Previously treated with d‑penicillamine**	**Group 2 Naïve to d‑penicillamine**

System Organ Class	Reaction	(N = 49)	(N = 17)
Blood and Lymphatic System Disorders	anemia	1 (2%)	1 (6%)
Gastrointestinal Disorders	nausea	12 (25%)	2 (12%)
	emesis	5 (10%)	–
	diarrhea/soft stools	9 (18%)	1 (6%)
	abdominal pain	–	1 (6%)
	oral ulcers	6 (12%)	3 (18%)
General Disorders and Administration Site Conditions	fever	4 (8%)	–
	weakness	2 (4%)	2 (12%)
	fatigue	7 (14%)	–
	peripheral (edema)	3 (6%)	1 (6%)
	chest pain	–	1 (6%)
Metabolism and Nutrition Disorders	anorexia	4 (8%)	–
Musculoskeletal and Connective Tissue Disorders	arthralgia	–	2 (12%)
Renal and Urinary Disorders	proteinuria	5 (10%)	1 (6%)
	impotence	–	1 (6%)
Respiratory, Thoracic and Mediastinal Disorders	cough	–	1 (6%)
Skin and Subcutaneous Tissue Disorders	rash	7 (14%)	2 (12%)
	ecchymosis	3 (6%)	–
	pruritus	2 (4%)	1 (6%)
	urticaria	4 (8%)	–
	skin wrinkling	3 (6%)	1 (6%)

Taste Disturbance
A reduction in taste perception may develop. It is believed to be the result of chelation of trace metals by tiopronin. Hypogeusia is often self-limited.

6.2 Postmarketing Experience

Adverse reactions have been reported from the literature, as well as during post-approval use of THIOLA. Because the post-approval reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to THIOLA exposure.

Adverse reactions reported during the postmarketing use of THIOLA are listed by body system in Table 2.

Table 2:	Adverse Reactions Reported for THIOLA Pharmacovigilance by System Organ Class and Preferred Term
System Organ Class	**Preferred Term**
Cardiac Disorders	congestive heart failure
Ear and Labyrinth Disorder	vertigo
Gastrointestinal Disorders	abdominal discomfort; abdominal distension; abdominal pain; chapped lips; diarrhea; dry mouth; dyspepsia; eructation; flatulence; gastrointestinal disorder; gastroesophageal reflux disease; nausea; vomiting; jaundice; liver transaminitis

General Disorders and Administration Site Conditions	asthenia; chest pain; fatigue; malaise; pain; peripheral swelling; pyrexia; swelling
Investigations	glomerular filtration rate decreased; weight increased
Metabolism and Nutrition Disorders	decreased appetite; dehydration; hypophagia
Musculoskeletal and Connective Tissue Disorders	arthralgia; back pain; flank pain; joint swelling; limb discomfort; musculoskeletal discomfort; myalgia; neck pain; pain in extremity
Nervous System Disorders	ageusia; burning sensation; dizziness; dysgeusia; headache; hypoesthesia
Renal and Urinary Disorders	nephrotic syndrome; proteinuria; renal failure
Skin and Subcutaneous Tissue Disorders	dry skin; hyperhidrosis; pemphigus foliaceus; pruritus; rash; rash pruritic; skin irritation; skin texture abnormal; skin wrinkling; urticaria

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

Available published case report data with tiopronin have not identified a drug-associated risk for major birth defects, miscarriage, or adverse maternal or fetal outcomes. Renal stones in pregnancy may result in adverse pregnancy outcomes (*see Clinical Considerations*). In animal reproduction studies, there were no adverse developmental outcomes with oral administration of tiopronin to pregnant mice and rats during organogenesis at doses up to 2 times a 2 grams/day human dose (based on mg/m^2). The estimated background risk of major birth defects and miscarriage for the indicated population is unknown. All pregnancies have a background risk of birth defect, loss, or other adverse outcomes. In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies are 2% to 4% and 15% to 20%, respectively.

Clinical Considerations

Disease-associated maternal and/or embryo/fetal risk

Renal stones in pregnancy may increase the risk of adverse pregnancy outcomes, such as preterm birth and low birth weight.

Data

Animal Data

No findings of fetal malformations could be attributed to the drug in reproduction studies in mice and rats at doses up to 2 times the highest recommended human dose of 2 grams/day (based on mg/m^2).

8.2 Lactation

Risk Summary

There are no data on the presence of tiopronin in either human or animal milk or on the effects of the breastfed child. A published study suggests that tiopronin may suppress milk production. Because of the potential for serious adverse reactions, including nephrotic syndrome, advise patients that breastfeeding is not recommended during treatment with THIOLA.

8.4 Pediatric Use

THIOLA is indicated in pediatric patients weighing 20 kg or more with severe homozygous cystinuria, in combination with high fluid intake, alkali, and diet modification, for the prevention of cystine stone

formation who are not responsive to these measures alone. This indication is based on safety and efficacy data from a trial in patients 9 years to 68 years of age and clinical experience. Proteinuria, including nephrotic syndrome, has been reported in pediatric patients. Pediatric patients receiving greater than 50 mg/kg tiopronin per day may be at greater risk *[see Dosage and Administration (2.1, 2.2), Warnings and Precautions (5.1) [see Adverse Reactions (6.1)]*.

THIOLA tablets are not approved for use in pediatric patients weighing less than 20 kg or in pediatric patients unable to swallow tablets *[see Dosage and Administration (2.1)]*.

8.5 Geriatric Use

This drug is known to be substantially excreted by the kidney, and the risk of adverse reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and it may be useful to monitor renal function.

10 OVERDOSAGE

There is no information on overdosage with tiopronin.

11 DESCRIPTION

THIOLA (tiopronin) immediate-release tablets are a reducing and cystine-binding thiol drug (CBTD) for oral use. Tiopronin is N-(2-Mercaptopropionyl) glycine and has the following structure:

Tiopronin has the empirical formula $C_5H_9NO_3S$ and a molecular weight of 163.20. In this drug product tiopronin exists as a dl racemic mixture.

Tiopronin is a white crystalline powder, which is freely soluble in water.

Each Thiola tablet contains 100 mg of tiopronin. The inactive ingredients in THIOLA tablets include calcium carbonate, carnauba wax, ethyl cellulose, dimethylaminoethyl methacrylate: butyl methacrylate: methyl methacrylate copolymer (Eudragit E 100), hydroxy-propyl cellulose, lactose monohydrate, magnesium stearate, povidone, sugar, talc, titanium dioxide.

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

The goal of therapy is to reduce urinary cystine concentration below its solubility limit. Tiopronin is an active reducing agent which undergoes thiol-disulfide exchange with cystine to form a mixed disulfide of tiopronin-cysteine. From this reaction, a water-soluble mixed disulfide is formed and the amount of

sparingly soluble cystine is reduced.

12.2 Pharmacodynamics

The decrement in urinary cystine produced by tiopronin is generally proportional to the dose. A reduction in urinary cystine of 250-350 mg/day at tiopronin dosage of 1 g/day, and a decline of approximately 500 mg/day at a dosage of 2 g/day, might be expected. Tiopronin has a rapid onset and offset of action, showing a fall in cystine excretion on the first day of administration and a rise on the first day of drug withdrawal.

12.3 Pharmacokinetics

Absorption
THIOLA Tablets
When THIOLA single doses were given to fasted healthy subjects (n = 39), the median time to peak plasma level (T_{max}) was 1 (range: 0.5 to 2.1) hours.

Elimination
Excretion
When tiopronin is given orally, up to 48% of dose appears in urine during the first 4 hours and up to 78% by 72 hours.

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenesis
Long-term carcinogenicity studies in animals have not been performed.

Mutagenesis
Tiopronin was not genotoxic in the chromosomal aberration, sister chromatid exchange, and *in vivo* micronucleus assays.

Impairment of Fertility
High doses of tiopronin in experimental animals have been shown to interfere with maintenance of pregnancy and viability of the fetus. In 2 published male fertility studies in rats, tiopronin at 20 mg/kg/day intramuscular (IM) for 60 days induced reductions in testis, epididymis, vas deferens, and accessory sex glands weights and in the count and motility of cauda epididymal sperm.

16 HOW SUPPLIED/STORAGE AND HANDLING

100 mg round, white, immediate-release tablet imprinted in red with “M” on one side and blank on the other side: Bottles of 100 **NDC** 0178-0900-01.

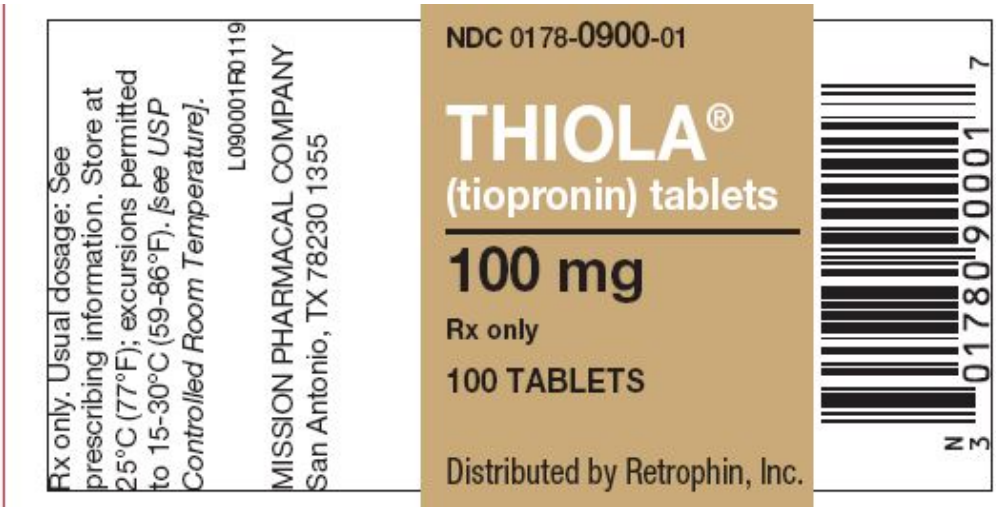
Store at 25°C (77°F); excursions permitted to 15-30°C (59-86°F) *[see USP Controlled Room Temperature]*.

17 PATIENT COUNSELING INFORMATION

Lactation
Advise women that breastfeeding is not recommended during treatment with THIOLA *[see Use in Specific Populations (8.2)]*.

Manufactured and packaged by Mission Pharmacal Company, San Antonio, TX 78230 1355
Distributed by Retrophin, Inc., San Diego, CA 92130

THIOLA ® Label
NDC: 0178-0900-01



THIOLA

tiopronin tablet, sugar coated

Product Information			
Product Type	HUMAN PRESCRIPTION DRUG	**Item Code (Source)**	NDC:0178-0900
Route of Administration	ORAL		

Active Ingredient/Active Moiety		
Ingredient Name	**Basis of Strength**	**Strength**
TIOPRONIN (UNII: C5W04GO61S) (TIOPRONIN - UNII:C5W04GO61S)	TIOPRONIN	100 mg

Inactive Ingredients	
Ingredient Name	**Strength**
POVIDONE, UNSPECIFIED (UNII: FZ989GH94E)	
HYDROXYPROPYL CELLULOSE (70000 WAMW) (UNII: 66O7AQV0RT)	
SUCROSE (UNII: C151H8M554)	123 mg
CALCIUM CARBONATE (UNII: H0G9379FGK)	42.7 mg
LACTOSE (UNII: J2B2A4N98G)	39 mg
DIMETHYLAMINOETHYL METHACRYLATE - BUTYL METHACRYLATE - METHYL METHACRYLATE COPOLYMER (UNII: 905HNO1SIH)	28.8 mg
ETHYLCELLULOSES (UNII: 7Z8S9VYZ4B)	20 mg
MAGNESIUM SILICATE (UNII: 9B9691B2N9)	14.4 mg
MAGNESIUM STEARATE (UNII: 70097M6I30)	5.4 mg
TITANIUM DIOXIDE (UNII: 15FIX9V2JP)	1.7 mg
CARNAUBA WAX (UNII: R12CBM0EIZ)	0.05 mg
FD&C RED NO. 40 (UNII: WZB9127XOA)	
ALUMINUM OXIDE (UNII: LMI26O6933)	

Product Characteristics

Color	WHITE	**Score**	no score
Shape	ROUND	**Size**	8mm
Flavor		**Imprint Code**	M
Contains			

Packaging

#	Item Code	Package Description	Marketing Start Date	Marketing End Date
1	NDC:0178-0900-01	100 in 1 BOTTLE; Type 0: Not a Combination Product	08/11/1988	

Marketing Information

Marketing Category	Application Number or Monograph Citation	Marketing Start Date	Marketing End Date
NDA	NDA019569	08/11/1988	

Labeler - Mission Pharmacal Company (008117095)

Registrant - Mission Pharmacal Company (927726893)

Establishment

Name	Address	ID/FEI	Business Operations
Mission Pharmacal Company		927726893	MANUFACTURE(0178-0900)

Revised: 6/2019 Mission Pharmacal Company