

BORATES

Description

Includes boron-containing compounds such as boric acid (boracic acid), borax (disodium tetraborate), sodium perborate, disodium octaborate tetrahydrate, zinc borate. Present in topical products for eyes, ear, and skin (mostly veterinary); vaginal products for yeast infections, diaper rinses, cleaners, insecticides (e.g. ant killers), wood preservatives, fire retardants (e.g. for cellulose insulation), and specialty fertilizers. Also used in metal and glass manufacturing.

Toxicity

Not corrosive. Significant toxicity from single, acute unintentional ingestion appears rare. Toxicity depends on route and duration of exposure. Wide range of individual susceptibility; newborns and infants appear to be at greater risk for serious toxicity.

Poisonings have followed ingestion, parenteral injection, enemas, lavage of serous cavities and application to damaged skin.

Mechanism of Toxicity

Mechanism not established. Borates may complex with enzymes and cofactors, acting as a generalized cellular poison at high levels. Most toxic to kidneys, brain, skin and gastrointestinal tract.

Toxic Dose

Toxic dose is not well established. However, single acute, unintentional ingestion rarely results in toxicity (see Case Reports).

Case Reports

acute In a retrospective review of 72 patients who ingested boric acid, 57 (79%) remained asymptomatic, 14 (19%) had minor self-limiting GI symptoms, and 1 patient died (probably chronic exposure, no details available). In another retrospective review of 782 acute boric acid ingestions (80% involving children < 6-years-old), most patients (88%) remained asymptomatic. In patients with symptoms, GI symptoms (vomiting, pain, diarrhea) were most common; lethargy, lightheadedness and rash were also reported. Doses ranged from 10 mg to 89 g; average dose in symptomatic patients was 3.2 g compared to 0.9 g in asymptomatic patients. Fewer than 5% of patients were admitted to hospital. No patients developed severe or life-threatening toxicity.

A 44-year-old ingested 14 g of boric acid and developed extensive exfoliation, alopecia, renal failure and mildly elevated liver enzymes. Patient received hemodialysis for renal failure; exfoliation was managed with daily antiseptic application. Patient recovered fully within 2 weeks.

A 77-year-old ingested eye wash solution containing 30 g boric acid and developed vomiting and diarrhea several hours later. Patient presented 23 hours later with erythema, vomiting, hypotension (systolic pressure 70 mmHg) and renal failure. Patient received pressors, dialysis, and ventilatory support but died 63 hours post ingestion of refractory hypotension.

Eleven newborns were given formula made with boric acid

2.5% solution. Most became symptomatic within 24 hours of feeding (vomiting, diarrhea, rash, dehydration, varied CNS effects) and 5 died. Fatal doses estimated to be 4.5-14 g (average 9.3 g); surviving newborns ingested 2-4.5 g (average 3.1 g).

chronic Ingestion of a borax/honey mixture applied to pacifiers caused seizure disorders in infants. Estimated borax doses ranged from 1-2 g/week for 4 weeks to 10 g/week for 12 weeks. Seizures began within 2 weeks. Other symptoms included irritability, rash and minor GI upset. No renal toxicity reported. Seizures stopped when borax/honey was stopped.

Pharmacokinetics

Readily absorbed from GI tract, burned or abraded skin, open wounds and serous cavities. Onset of GI symptoms may be rapid following ingestion; usually delayed several hours following dermal exposure. Distributed throughout body but concentrates in brain, liver and kidneys. Primarily eliminated in urine. Elimination half-life is estimated at 5-21 hours.

Clinical Effects

- **Topical:** May produce irritation. Alopecia has been reported with scalp exposure to borax. Repeated dermal exposures to damaged skin may produce systemic toxicity.
- **Ocular:** Irritation may occur.
- **Inhalation:** Borax dust may cause dryness of mouth, nose, throat; cough, nose bleeds. Respiratory tract irritation with shortness of breath and bronchoconstriction have been reported.
- **Ingestion:**
 - General:** Single, *acute* small ingestion is not likely to result in significant toxicity. Larger ingestions may result in severe GI symptoms, volume depletion, hypotension, CNS depression. Renal failure may occur in severe cases. Death can occur from cardiac or respiratory failure. With *chronic* ingestions, symptoms can be similar as those seen with acute but may be absent or insidious.
 - CVS:** Hypotension and cardiovascular collapse may be seen in those with severe GI symptoms.
 - Neurologic:** Headache, irritability, weakness, lethargy; convulsions (usually after multiple exposures), CNS depression, coma.

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GI: Nausea, vomiting, abdominal pain, diarrhea. Vomitus and feces may be blue-green colour. May lead to volume depletion, hypotension and shock.

Hepatic: Elevated liver enzymes reported (usually reversible and mild).

GU: Transient oliguria or anuria; renal failure in severe cases.

Fluids/Lytes/Acid-Base: Metabolic acidosis.

Blood: Anemia.

Skin: Localised erythema ("boiled lobster" appearance) becoming more generalised within 24 hours, followed by excoriations, bullae and desquamation developing over 3-5 days. Alopecia can occur (delayed).

Treatment

1. **Topical:** Wash skin thoroughly with water. For chronic exposures, assess for systemic toxicity.
2. **Ocular:** Flush eyes with a gentle stream of tepid water for 5 minutes. Obtain ophthalmologic opinion if irritation persists.
3. **Inhalation:** Humidified oxygen may provide relief from irritation. Treat bronchoconstriction as required.
4. **Ingestion:** Single, acute ingestion of a small amount is unlikely to produce toxicity and generally does not require treatment.
5. GI decontamination may be considered if a large amount has been recently ingested and spontaneous vomiting has not occurred. Activated charcoal does not bind boric acid efficiently; data is lacking for other borates.
6. Monitor vital signs, renal function.
7. Maintain fluid and electrolyte balance.
8. Hypotension unresponsive to IV fluids may be treated with vasopressors.
9. Seizures may be treated with IV benzodiazepines.
10. Peritoneal dialysis and hemodialysis increase elimination of borates. May be required for renal failure and may be considered in severe cases not responding to supportive measures.

Key Points

- ✓ Serious toxicity following single, acute unintentional ingestion of borates is uncommon.
- ✓ Patients with symptoms beyond self-limiting vomiting or diarrhea (e.g. dehydration, erythema, lethargy, decreased urine output) require assessment at a health care facility.
- ✓ Treatment is mainly symptomatic and supportive.