Strychnine: A review of toxicity
Jared Cavanaugh, PharmD

Strychnine is produced from the trees Strychnos nux-vomica and other Strychnos species. It is a colorless, odorless, bitter tasting powder commercially available as nitrate, sulfate, or phosphate salts. Brucine is a related, less potent alkaloid from the nux-vomica tree.

Strychnine was first used as a rodenticide but was later implemented as treatment for a variety of medical purposes. Strychnine has been used as a cardiac, respiratory, and digestive stimulant, an analeptic, an antidote for barbiturates and opioids, for sleep apnea, snake bites, and nonketonic hyperglycinemia. It used to be a major cause of death and poisonings but has been removed from medical preparations and is currently only licensed as an underground rodenticide in the United States, which has further limited unintentional poisonings. While strychnine is still used as a medical therapy in a few cultures, most exposures are due to suicide or homicide attempts. The Chinese herb Maqianzi, which is used to treat inflammatory conditions and paralysis, and slang nut, a Cambodian remedy used for gastrointestinal diseases, contain strychnine. It has also been found as an adulterant in drugs of abuse, sometimes intentionally, which is colloquially referred to as a “death hit”.

Strychnine inhibits glycine receptors postsynaptically, lowering the threshold required for depolarization of the interneurons in the spinal cord. This decrease in inhibitory influence on the spinal reflex arc results in increased muscle impulses and contraction. This mechanism the clinical effects are similar to that of tetanus, which inhibits glycine release presynaptically.

Strychnine toxicity leads to involuntary muscle contractions, resulting in musculoskeletal pain, loss of ventilation, hyperthermia, and rhabdomyolysis. Larger muscle groups predominate, leading to trismus, opisthotonos, risus sardonicus, upper extremity flexion and lower extremity extension. These contractions are triggered via stimulation such as touch, noise, or light. As strychnine primarily acts in the spinal cord the patient is fully conscious, leading to the contractions being described as “conscious seizures” or “spinal seizures”. The patient may be hemodynamically unstable with hypertension and hypotension reported with both tachycardia and bradycardia. Nystagmus, clonus, and hyperreflexia can occur along with nonspecific dizziness, or vomiting. Morbidity and mortality are often due to contraction induced hypoventilation, hyperthermia, and rhabdomyolysis. Symptoms of strychnine toxicity may last between 24-48 hours.

Strychnine poisoning can often be distinguished from seizures as the patient will maintain their consciousness during the bilateral convulsions and will not undergo a post-ictal period. Tetanus also shares this trait; however, tetanus typically has a more gradual onset and a patient history may contain a wound or injectable drug use with incomplete vaccination.
Metabolic and respiratory acidosis are common and while often severe, the hyperlactatemia and degree of acidosis does not correlate with mortality as the lactate is a result of excessive generation from muscular activity and not due to a metabolic disturbance. Rhabdomyolysis resulting in kidney damage may occur. The electrocardiogram typically remains normal or reflects the associated electrolyte disturbances resulting from rhabdomyolysis. Drug concentrations can be obtained, however clinical utility is minimal as results are often delayed and concentrations do not correlate well with toxicity.

Management of strychnine toxicity mainly consists of aggressive supportive care. Gastrointestinal decontamination with charcoal is effective at typical doses, and lavage may be considered however care should be taken to ensure the airway is protected. The most important treatment measures are maintaining adequate oxygenation and ventilation, and rapid cooling of hyperthermic patients. This can be accomplished by external cooling methods and stopping muscular activity. Unnecessary stimulation should be avoided and the patient should be placed in a dark, quiet environment. Benzodiazepines restore inhibitory function to the spinal reflex arc and should be administered initially at standard doses, increasing until contractions have stopped. Other GABAergic medications such as barbiturates or propofol can be considered. If control cannot be achieved with sedation alone, neuromuscular blockers are recommended. Succinylcholine causes initial muscle contractions and can exacerbate hyperkalemia, thus non-depolarizing agents should be used. It is important to adequately sedate the patient as strychnine does not alter consciousness. Therapies can be tapered as the toxicity resolves, typically after 24 hours. Intravenous fluid administration to maintain adequate urine output is recommended due to the risk for rhabdomyolysis, however forced diuresis has not shown to be effective at increasing elimination. As strychnine has a large volume of distribution, extracorporeal elimination is not likely to be effective.

References