

# Acute Arsenic Suicidal Poisoning – A Rare Case

R. Rajavardhan<sup>1\*</sup>, Anand Mamadapur<sup>2</sup> and N. Shyamala<sup>3</sup>

<sup>1</sup>Critical Care Medicine, Manipal Hospital Whitefield, Bangalore - 560066, Karnataka, India; rajavardhan99@gmail.com

<sup>2</sup>Critical Care Medicine, Sakra World Hospital, Bangalore - 560101, Karnataka, India; amamdapur@gmail.com

<sup>3</sup>Department of Anesthesiology, NIMHANS, Bangalore - 560029, Karnataka, India; Shyamala.narayanan@gmail.com

## Abstract

Arsenic is a naturally occurring element in the earth's crust. Chronic arsenic poisoning has been regularly reported predominantly due to occupational exposure in the literature. Acute arsenic poisoning is very rare. A 27-year-old gentleman was brought to the hospital with a history of suicide attempt by consumption of arsenic trioxide diluted in water. He initially manifested with gastrointestinal manifestations along with tachycardia. The patient was treated with fluid resuscitation, antidote-Dimercaprol, dialysis, and other supportive treatment. The patient continued to deteriorate with deranged liver and renal function, coagulopathy, and neurological symptoms. The presence of coagulopathy further complicated the scenario, as the antidote which is administered as an intramuscular injection could not be given. The patient continued to deteriorate and eventually succumbed. Acute arsenic poisoning is very rare, and very few reports of suicide are reported. It initially presents with acute gastroenteritis symptoms followed by multi organ involvement. Fatal doses will invariably result in death irrespective of treatment modality. Rapid administration of antidote and supportive treatment might increase the chances of survival. Difficulty in the availability of oral antidote and unavailability of any Intravenous preparations further complicates the scenario.

**Keywords:** Arsenic, Gastroenteritis, Liver Failure, Poisoning, Suicidal

## 1. Introduction

Arsenic is a naturally occurring element found in the earth's crust. Human exposure can occur either from natural resources e.g. volcanic eruptions, contaminated drinking water, or via occupational exposure, such as in smelting and refining.<sup>[1]</sup> Acute arsenic poisoning will present with gastrointestinal symptoms such as vomiting, severe watery diarrhea which is usually followed by dehydration and hypotension. It can also lead to cardiac

manifestations such as QTc (corrected QT) prolongation and subsequent torsades de pointes. The lethal dose of arsenic in acute poisoning may range from 100-300 microgram/kg.

Low dose chronic exposure can result in subacute/ chronic poisoning that can include skin changes, skin cancer, peripheral sensorimotor neuropathy, diabetes mellitus, cardiovascular side effects, hepatotoxicity. Suicidal ingestion of arsenic is rare and high doses invariably result in mortality.

\*Author for correspondence

## 2. Case Report

A 27-year-old gentleman employed as a laboratory technician presented to our hospital within 3 hours of suicidal ingestion of arsenic trioxide 10 grams diluted in 10 ml of water. The patient was administered a gastric lavage in the emergency department and shifted to the intensive care unit.

On arrival to the ICU, the patient was having a sinus tachycardia with a heart rate of 130 bpm, blood pressure of 110/62 mmHg, and room air saturation of 97%. Laboratory data revealed serum potassium of 3.2 mEq/L. The patient was resuscitated with intravenous fluids and potassium chloride supplementation. A central venous cannula and an arterial line were secured for continuous hemodynamic monitoring. Serum potassium of 4 mEq/L and magnesium of 1.8 mEq/L was targeted to minimize cardiac side effects.

Blood arsenic level was 581.16 mcg/L and spot urine arsenic level was >5500 mcg/L.

6 hours after admission, sinus tachycardia worsened to 150bpm with QTc of 547ms and ST wave depression in

inferolateral leads. The patient developed frequent watery stools. Vasopressors were initiated for hypotension refractory to fluid resuscitation. Hemodialysis was initiated for the possible theoretical benefit. Dimercaprol (BAL) was started at the dose of 5 mg/kg divided q6h deep Intramuscular route (IM). The patient was electively ventilated.

On day 2, the patient was noted to emit a garlic odour. Loose stools persisted with the onset of paresthesia in the legs. The patient developed an altered sensorium later in the day. Laboratory data revealed worsening liver function, renal function, and coagulopathy (Table 1 and 2). Intravenous fluids and vasopressors were continued. Coagulopathy was corrected with fresh frozen plasma. BAL and hemodialysis were continued.

On day 3, liver and renal functions continued to deteriorate with coagulopathy and thrombocytopenia. Intramuscular gluteal hematoma noted with oozing from the injection site and dimercaprol was stopped. Upper gastrointestinal bleeding was noted which managed with fresh frozen plasma, injection vitamin K was the patient continued to deteriorate and succumbed to death.

**Table 1.** Liver function tests

Laboratory parameters	Day 1	Day 3
Total bilirubin (mg/dl)	1.5	4.5
Direct bilirubin(mg/dl)	0.36	2.08
Indirect bilirubin(mg/dl)	1.14	2.42
SGOT(IU/L)	36	402
SGPT(IU/L)	16	304
Alkaline phosphatase(IU/L)	59	39
Total protein(g/dl)	5.8	26
Albumin(g/dl)	3.2	5.5
Globulin(g/dl)	2.6	2.3
LDH(IU/L)	161	273

**Table 2.** Renal function test, Coagulation profile

Laboratory data	Day 2	Day3
Serum creatinine (mg/dl)	1.42	1.48
Na(mmol/L)	137	134
K(mmol/L)	4.2	5
PT (seconds)	20.3	82
INR	1.82	7.47
Platelet(thous/ul)	291	89
Magnesium (mg/dl)	1.9	1.7
Creatine phosphokinase	-	3146 IU/l

### 3. Discussion

Arsenic is a metalloid that exists in multiple forms such as gaseous, organic, and inorganic (trivalent and pentavalent). Trivalent arsenic i.e. arsenic trioxide has been successfully used in the treatment of leukemias (acute promyelocytic leukemia), lymphomas, and multiple myelomas as well as the variety of solid tumors<sup>[1]</sup> Melarsoprol is a trivalent organic arsenical compound that has been used in Africa and parts of Europe to treat the Meningoencephalitic stage of both species of African trypanosomes. Contaminated soil, water, food, and gas can be primary sources of arsenic for the general population.<sup>[2]</sup> Consumption of contaminated seafood and water are responsible for large-scale outbreaks of chronic toxicity, Arsenic poisoning can be unintentional, suicidal, homicidal, occupational or iatrogenic. Suicidal cases of acute arsenic poisoning are rare given the difficulty of access to the general population.<sup>[3,4]</sup>

Arsenic trioxide in aqueous solution is more toxic than an identical dose of undissolved Arsenic trioxide eaten in food because of failure to dissolve, thereby limiting absorption. The oral bioavailability of aqueous Arsenic trioxide is more than 90%. Skin absorption of arsenic is

minimal, but it can cross the placenta and can accumulate in the fetus. Arsenic is readily taken up by RBCs and then quickly redistributed to other tissues - liver, kidney, muscle, skin, and brain. Finally, it will be distributed to most of the tissues in the body. The majority of trivalent arsenic is metabolized via methylation to form the Monomethylarsonic Acid (MMA) followed by Dimethyl Arsenic Acid (DMA) and excreted in the urine. Trivalent arsenic the most toxic form avidly binds to sulfhydryl groups (proteins, glutathione, cysteine) and interferes with numerous enzyme systems, such as those involving cellular respiration (inhibits pyruvate dehydrogenase, gluconeogenesis, glucose uptake a glutathione metabolism. The estimated lethal dose of Arsenic trioxide LD<sub>50</sub> doses was 1.43 mg/kg. Large doses of Arsenic trioxide can result in the early onset of symptoms.

An acute manifestation of poisoning by the oral route is invariably nausea, vomiting, pain abdomen, and severe watery diarrhea. It will develop within minutes to hours. There will be garlic odor in the breath and stool of most of the patients. This severe watery diarrhea has been referred to have choleroïd diarrhea because of rice watery appearance. This might result in the massive fluid loss from the gastrointestinal tract resulting in hypotension

and dyselectrolytemia. Gastrointestinal mucosal damage may lead to bleeding. Cardiac manifestations include sinus tachycardia, long QT syndrome, arrhythmias, shock, and cardiac arrest in systole. Arsenic affects cardiac repolarisation currents resulting in ventricular dysrhythmias including torsades de pointes. Sinus tachycardia might develop secondary to hypovolemia, toxic effects as well as dyselectrolytemia. Shock can develop due to severe diarrhea, leaky capillaries, and myocardial dysfunction. Hepatitis can occur due to altered intrahepatic heme metabolism or altered protein transport between hepatocytes, which results in increased synthesis of bilirubin. Acute kidney injury can occur secondary to ischemia caused by hypotension, tubular deposition of myoglobin or hemoglobin, renal cortical necrosis, and direct renal tubular toxicity. Encephalopathic findings include headache, confusion, decreased memory. Personality change, irritability, hallucinations, delirium, and seizures. Peripheral neuropathy usually developing weeks after poisoning manifests as sensory symptoms progressing to tingling, numbness. May progress to motor symptoms manifesting as ascending flaccid paralysis. Reported cases of patients developing symptoms within 24 hours are also there. It may present with ARDS, hemolytic anemia. Unusual complications include phrenic nerve palsy, facial nerve palsy, pancreatitis, pericarditis, and pleuritis. If the history of poisoning is not clear, it may be misdiagnosed as acute gastroenteritis, sepsis, myocardial infarction. Death may happen within a week if large doses are ingested.

History should identify potential sources of exposure and symptoms consistent with arsenic poisoning. Urine-it tends to be the measure of recent exposure since arsenic is rapidly cleared by blood. Inorganic arsenic will be metabolized by MMA and DMA, all of which are predominantly excreted in the urine. Unless specifically asked for these, it will be reported as total arsenic. Usually, the spot sample is taken and measured for arsenic and corrected for concentration by also ordering a urine creatinine. A definitive diagnosis can be established if a concentration greater than 50 micrograms per liter. Blood arsenic levels are variable and unreliable because of rapid tissue uptake.<sup>[5,6]</sup>

Acute arsenic poisoning is life-threatening and requires basic as well as advanced life support. The

patient requires admission to the intensive care unit and aggressive resuscitation and support of organ systems.

Management of acute poisoning patient includes

- Decontamination - removes contaminated clothing and wash from the skin and hair.
- Gastrointestinal decontamination - it is controversial since arsenic poorly adsorbs onto activated charcoal.
- Activated charcoal can be used with airway protection because of the concerns of nausea, vomiting, and altered mental status.
- Fluid resuscitation forms the mainstay in the management to combat hypovolemia caused by diarrhea and capillary leak.
- Monitor and correct electrolyte imbalance to prevent long QT/arrhythmias.
- Hemodynamic monitoring for hypotension, arrhythmias, fluids and electrolyte imbalances.
- Chelation therapy.

Chelation therapy is indicated in acute poisoning, symptomatic arsenic poisoning patients with chronic poisoning. Two chelating agents are widely used: intramuscular Dimercaprol (BAL) and oral 2,3 dimercaptosuccinic acid (succimer). A third drug unithiol is also available. All contain vicinal dithiol moieties that bind arsenic to form stable 1,2,5 arsodithiolanes.

BAL remains the initial chelating agent of choice in severe acute poisoning. Different dosing regimens have been advised by toxicological experts. A regimen for administering 3 to 5 mg/kg of deep IM administered every 4-6 hours is usually recommended. The endpoint of chelation is a 24 hour urinary arsenic of <50mcg/ml. Early initiation of BAL within 24 hours increases survival and improves encephalopathy. BAL has a narrow therapeutic: toxic ratio with significant side effects. It should be used with caution in G6PD deficiency patients.

Succimer is an oral hydrophilic analog of BAL and is the chelator of choice for subacute and chronic toxicity. DMPS is a water analog of BAL. it can be administered by oral, intravenous, and intramuscular routes. Because of the limitations of currently available chelators, research is ongoing to find better chelators to treat arsenic toxicity.

Hemodialysis removes some amount of arsenic with or without concomitant BAL therapy. In patients with AKI, hemodialysis clearance range from 76 to 87.5 ml/min with or without BAL therapy.

## 4. Conclusion

Acute arsenic suicidal poisoning is very rare and if taken at high doses will invariably result in fatality. Our case presented initially has gastroenteritis followed by rapid progression to multisystem involvement cardiac, kidney, liver, coagulopathy, and the brain eventually leading to death. Early initiation of BAL remains the mainstay of therapy. But in the presence of coagulopathy and difficulty in giving IM dose further complicates the scenario. Timely availability of other chelators and their ineffectiveness during acute toxicity invariably lead to death.

## 5. References

1. Mundy SW. Arsenic. Goldfrank's Toxicologic Emergencies. 10<sup>th</sup> ed. New York: Mcgraw-Hill Education; 2015. p. 1169.
2. Windebank A. Arsenic. Experimental and Clinical Neurotoxicology, Spencer PS, Schaumburg HH. New York: Oxford University Press; 2000. p. 203.
3. Duncan A, Taylor A, Leese E, Allen S, Morton J, McAdam J. Homicidal arsenic poisoning. *Annals of Clinical Biochemistry: An International Journal of Biochemistry and Laboratory Medicine*. 2014; 52(4):510-515. <https://doi.org/10.1177/0004563214559222>. PMID:25344454
4. Tournel G, Houssaye C, Humbert L, Dhorne C, Gnemmi V, Bécart-Robert A, et al. Acute arsenic poisoning: Clinical, toxicological, histopathological, and forensic features. *Journal of Forensic Sciences*. 2010; 56:S275-S279. <https://doi.org/10.1111/j.1556-4029.2010.01581.x>. PMID:20950314
5. Feldman R. Arsenic. Occupational and Environmental Neurotoxicology. Feldman RG, editors. Philadelphia: Lippincott-Raven; 1999.
6. Orloff K, Mistry K, Metcalf S. Biomonitoring for environmental exposures to arsenic. *Journal of Toxicology and Environmental Health, Part B*. 2009; 12(7):509-524. <https://doi.org/10.1080/10937400903358934>. PMID:20183531

**How to cite this article:** Rajavardhan R, Mamadapur A and Shyamala N. Acute Arsenic Suicidal Poisoning – A Rare Case. *Int. J. Med. Dent. Sci.* 2021; 10(1): 1961-1965.