

## A Review Study on Mercury Poisoning and it's Treatment

Dr. Amar B. Patil<sup>1</sup>, Dr. Prafull A. Patil<sup>2</sup>, Dr. Vishal Shamrao Patil<sup>3</sup>

<sup>1</sup>Associate Professor, Department of Agad Tantra, Jaywant Institute of Medical Science, Sangli, Maharashtra, India

<sup>2</sup>Associate Professor, Agad Tantra Department, Pradip Patil Ayurvedic Medical College, Khutalwadi, Maharashtra, India

<sup>3</sup>Professor, Kriya Sharir Department, Pradip Patil Ayurvedic Medical College, Khutalwadi, Maharashtra, India

### ABSTRACT

Metallic mercury, also known as quicksilver, is a liquid metal with a bright silvery lustre. It exists in nature as the metal itself and as the sulphide (cinnabar or *ras sindoor*). Metallic mercury is not poisonous if swallowed because it is not absorbed. It vaporizes at room temperature and causes poisoning if vaporized mercury is inhaled, swallowed, or rubbed into the skin. Mercury depresses cellular enzymatic mechanisms by combining with sulphhydryl groups. Mercuric compounds being soluble are more poisonous than mercurous compounds which are less soluble. Mercury poisoning refers to toxicity from mercury consumption. Mercury is a type of toxic metal that we can come into contact with in a variety of ways. This may include consuming certain types of seafood and wearing certain types of jewellery.

**KEYWORDS:** metal poison, mercury, legal aspect, chikitsa

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### INTRODUCTION

Any substance if, taken in any account, by any route, produces harmful effect (i.e., disease, deformity or death) over the body then it will be called as poison<sup>1</sup>. Mercury is a metallic poison which holds a great deal of significance in both Ayurveda and Modern Toxicology. In Ayurveda it is claimed to have originated from semen of Lord Shiva<sup>2</sup>. It is a component of several formulations in Ayurveda which are prescribed for variety of illnesses. In addition to its therapeutic benefits, it has adverse effects on the body if it is not purified. According to Ayurveda literatures it is having eight doshas namely Vishaor Garala, Vahni or Agni, Mala, Naga, Vanga, Chapalya, Giri and Asahyagni which causes Mruthvu or Marana (death), Santapa (rise in body temperature), Jadya (heaviness), Vrana (wound), Kushta (skin diseases), Sukraksaya (depletion of Semen), Sphota (boils over skin) and Moha (delirium) respectively<sup>2</sup>. In current era mercury is used in different industries like thermometer, ceramics, dry cell batteries, electrical appliances, explosives, fireworks, mercury vapor lamps, paints, pesticides

etc. and therapeutically like antiseptics, disinfectant, dental amalgam, diuretic, purgative etc. which makes the person to get more exposure to mercury leading to acute or chronic mercury toxicity<sup>3</sup>. Mercury poisoning and its treatment are thoroughly described in modern toxicology, however in Ayurveda this is only covered in few literatures, Bhaishajya ratnavali is one among them. The author has dedicated a separate chapter by name Paradavikara chikithsa and thoroughly explained about the importance, source of exposure, clinical feature, its treatment, do's and don'ts<sup>4</sup>.

Mercury is a toxic metal and has caused several large public health crises throughout the world. The most common cause of mercury poisoning is from consuming too much methylmercury or organic mercury, which is linked to eating seafood. Mercury itself is naturally occurring, but the amounts in the environment have been on the rise due to industrialization. The metal can make its way into soil and water, and eventually into animals like fish<sup>5,6</sup>.

**MATERIALS AND METHODS<sup>7-12</sup>.****General Information-**

1. Sanskrit Name:- Parada
2. Chemical Name:- Hg
3. Gujarati Name:- Paro
4. English Name:- Quick silver

**Classification:-**

1. Acc. To Ayurveda - Sthavara –Metal poison
2. Acc. To Modern :-
  - i) Irritant – Inorganic – Metallic
  - ii) Nephrotoxic poison

**Sources of mercury:**

Compounds of mercury:-

1. Mercuric chloride  $\text{HgCl}_2$  .
2. Mercuric oxide ( $\text{HgO}$ )
3. Mercuric cyanide {  $\text{Hg}(\text{CN})_2$  }
4. Mercuric sulphide
5. Mercurous chloride { (  $\text{Hg}_2\text{Cl}_2$  ) }
6. Mercuric nitrate {  $\text{Hg}(\text{NO}_3)_2$  }

\* Mercuric:- Which are soluble and intensely poison.

\* Mercurous:- Which are less soluble and less intense poison. If mercury is breath or swallowed as vapour or applied to the skin of mucous membrane it will be absorbed quickly.

3. Mechanism of action: - Mercury depresses cellular enzymatic mechanism by combining with sulphhydryl {SH} groups.
4. Fatal Dose: - corrosive sublimate (mercuric chloride) = 1-4 gm.
5. Fatal Period:- 3-5 days.

**Sources-**

Mercury can be inhaled, absorbed through the skin or eyes, or ingested. The most common ways you might be exposed to mercury are through:

**Fish.** When elemental mercury makes its way into water sources, it's consumed by small fish. The small fish are eaten by bigger fish, and eventually, the predators at the top of the food chain end up with a lot of mercury in their tissues. Tuna, swordfish, and sharks are examples of fish that tend to be high in mercury.

**Dental fillings.** Modern-day dental fillings have a low level of mercury that is safe for many people. Nevertheless, there's still a risk of ingesting harmful elemental mercury vapor.

**Work environments.** Working at a landfill, with mercury thermometers, or in a workplace with broken fluorescent and low-energy bulbs puts you at higher risk of mercury poisoning.

**Symptoms:**

Nasabanga (sinking of the nose bridge), peenasa (rhinitis), dantapatana (premature falling of teeth),

netraroga (diseases of eyes), mukharoga (diseases of mouth), visarpa (herpes), kota (wheels), kandu (itching), mastakapeeda (discomfort in head), vaivarnya (discoloration), nasakshata (damage to nose), vedana (pain), shotha (edema), granti (tumor) in andakosha (scrotum), pakshagata (paralysis), asthipadahastadaha (burning sensation in bone, palm and soles), chittavikruti (mental illness), bhagandara (fistula), kushta (skin disorders), upadamsha (chancre) etc. are seen.

Due to mercurial poisoning dantavestana (falling of teeth), sarakta (reddishness) mruduta (softness), shvayatu (swelling) and kshata (damage) of teeth will occur. There will be suchiviyada (prickling pain) and bahuchidrata (pores) in gums. There will deposition of mala (dirtiness) and shithilata (loosening) of teeth. There will be lalasrava (excessive salivation) and dhatu rasa swada (metallic taste) in the mouth. There will be formation of shotha (oedema) and darunata (damaged) in tongue. The body becomes krusha (lean). It causes galashundi (tonsilitis), granti (tumour) or shotha (swelling) in gala (throat), karna (ear), hanu (mandible region).

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The excessive intake of purified mercury can lead to jawara (fever), shariraindriyashaitilya (loosening of body and organs), dantapata (falling of teeth), breaking of hanvasti (mandible), mukavidradi (mouth ulceration), raktapitta (bleeding disorder) and pandu (anemia). Inhaling mercury can cause kampa (stammering), which starts in the vadana (face) and eventually spreads to the arms and legs. The patient's mamsapeshi (muscles) become incredibly durbala (weak), and their perceptions are impaired.

**Acute poisoning:**

1<sup>st</sup> phase:

- Metallic taste with a feeling of constriction in the throat, burning sensation from mouth to stomach, and pain radiating over the abdomen
- The mouth, tongue, and faeces become corroded and the mucous membrane appears greyish white.

There is nausea, with frequent vomiting of long stringy masses of white mucus, mixed with blood, followed by profuse purging, often bloody, with painful tenesmus.

- Collapse sets in, with cold clammy skin, pale anxious face, sunken eyes, dilated pupils, rapid feeble pulse, and sighing respirations
- Syncope, convulsions and general insensibility usually precedes death which may take place in few hours.
- 2<sup>nd</sup> phase:
- If death is not rapid, on the second or third day, salivation may develop, the gums may become swollen and inflamed, and the breath foul. Some loosening of teeth and ulcerative glossitis may follow.
- A renal lesion soon appears due to **nephrotoxicity** of mercury. The urine contains albumin and blood and death ensues from uraemia. Caecum and large intestine show area of erosion, corrosion, and necrosis, due to re-excretion of mercury.
- Recovery may occur within 10-14 days. \*\*500 mg Hg pass from urine in 24 hours, it is signs of poisoning from Hg.

#### Chronic Mercury poisoning: -

This may result from; i) continuous absorption by workers, due to handling of mercury & mercury compounds and, inhalation of vapour of mercury. ii) Excessive therapeutic use. (Specially rasaasadihi) iii) If ointment is used as external application for a long time. iv) From recovery of large dose poisoning. v) By using fingerprint solution. vi) In dental procedure by amalgam it can cause poisoning

#### ➤ Symptoms of chronic stage-

- 1]Salivation, Metallic taste & gastrointestinal disturbance.
- 2]Inflammation of gums.
- 3]Occasionally blue line at junction of teeth.
- 4]sore mouth and throat
- 5]loosing of teeth.
- 6]Chronic nausea and pain.
- 7]Typical symptoms: - Paralysed of speech muscle.

**Fatal dose:** 1-2 gms of corrosive sublimate

**Fatal period:** within a few hours but may be delayed for 3-5 days.

#### Treatment:

- Ayurvedic treatment:- ---
- 1. Egg white and milk (Demulcents)
- 2. Treatment of shock is given.
- 3. Gargling with Triphala decoction.

4. Tab. Of Mahagandhaka rasayana 500 mg twice a day.

- Shudha Gandaka (purified Sulphur) mixed with Honey has to be taken internally. Method of use /Administration: Taken in a dose of 4 Ratti (~500mg), twice or thrice a day. Therapeutic benefits: Taking pure Sulphur cures the damage caused by mercury poisoning and treats all of its ill effects. The patient's body returns to its original colour and radiance. It is said that there is no better medicine of mercurial poisoning than this.

- **Triphaladi Kwatha Ingredients:** Triphala (Combination of Emblica officinalis Gaertn, Terminalia chebula Retz and Terminalia bellirica Roxb), katuki (Picrorhizakurroa), shatavari (Asparagus racemosus), patolapatra (Trichosanthes dioica Roxb), amrita (Tinospora cordifolia), parpata (Fumaria parviflora Lam) and water. Process of Drug-Making: All the ingredients to be taken in equal quantity and make coarse powder and mix them together. Take 2 tola (~24 gm) measure of this mixture and make into decoction by adding water measuring 32 tola (~384 ml). When the original quantity is reduced to one fourth, remove the preparation from the stove and filter it.

- **Sarivadyaavaleha Ingredients:** Sariva (Hemidesmus indicus R.Br.), water, Shatavari (Asparagus racemosus Wild), katuki (Picrorhizakurroa), guduchi (Tinospora cordifolia), triphala (Combination of Emblica officinalis Gaertn, Terminalia chebula Retz and Terminalia bellirica Roxb), nisotha (Operculina turpethum Linn), herbs of the jivaniyagana (Vitalizing group), trayamana (Gentian kurroa Royle Linn) and milk. Process of Drug-Making: Obtain tulapramana (~5 kg) of sariva and get it finely powdered. Cook it into water measuring 1 drona (~12 kg.288gms) so long as the original quantity is reduced to one fourth part. Add to this, the fine powder measuring 2 aksha (~24 gm). Each of the following: shatavari, katuki, guduci, triphalā, nishotha, herbs of the jivaniyagana. Triphala group and trayamana. Cook again the preparation like an avaleha (linctus) and add to it honey measuring 8 pala (~384 gm).

- **Method of use / Administration:** This drug should be taken in doses of 1 karsha (~12 gm) along with milk. Therapeutic benefits: This drug effectively treats the mercurial poisoning as well as other diseases such as blood related ailments, pidaka (eruption), upadamasha (chancre), twenty types of prameha (diabetes) and other similar

diseases. It increases the strength, luster and digestive power of person who takes it.

• Modern treatment:-

- Stomach should be washed out with 250 ml of 5 % solution of **sodium formaldehyde sulfoxylate** and about 100 ml of this solution left in the stomach.
- Egg albumin
- Medicinal charcoal with magnesium sulphate
- BAL and penicillamine derivatives (cuprimine)

Administration of alkaline fluids, peritoneal dialysis or haemodialysis where the kidney shows signs of damage.

- General treatment of shock and collapse and symptomatic treatment.

**Postmortem appearances:**

- If the poison is taken in a concentrated form, signs of corrosive poisoning will be present otherwise the appearance of irritant poisoning will be observed.
- The tongue is white and sodden in appearance and the mouth generally has a diffuse greyish white escharotic appearance.
- The mucus membrane of the alimentary tract is inflamed and corroded.
- The muscular coat is so softened that it is difficult to remove without the rupture.

Mercury has a selective action on the caecum and large intestine which show intense inflammation, ulceration, and even gangrene.

- The kidneys show a toxic nephritis.
- The liver and kidney may show fatty degeneration, and heart shows subendocardial haemorrhages also.

**Chronic poisoning:** this may be the result of -

1. The after effects of an acute attack
2. Injudicious medical administration
3. Continuous accidental absorption in those working with the metal or its salt.

**Signs and symptoms:**

- Excessive salivation with metallic taste in the mouth, loosening of teeth with painful inflamed gums, and occasionally a blue-black line on the gums as with lead poisoning. Irritation of the skin may occur.
- Nephritis is a serious complication.
- Abortion is common.

**Mercuria lentis**, i.e. discoloration of the capsule of the lens of the eye due to deposition of mercury, as observed through a slit lamp, is one of the chronic mercury poisoning. It has no effect on visual acuity.

- Nervous symptoms, such as tremors, and mental symptoms known as **erethism** are seen.

The tremor is known as the **hatters shake**, because it is common in workers of that industry. It is coarse, intentional, and affects the hands, arms, tongue, and later the legs.

- Erethism is a peculiar disturbance of the personality characterized by shyness, irritability, tremors, loss of memory and insomnia. It is common in workers in mirror industry.

➤ **Symptoms –**

- Pink disease more common in children
- Minimata disease
- Mercuria lentis
- Danbury syndrome

**Postmortem appearance:**

- Changes in large intestine, due to partly to re-excretion, are often very striking, with necrosis which spreads, and may involve practically the whole of the lower bowel.
- Kidney damage consisting of tubular nephritis, and fatty degeneration of the liver and cardiac muscles.

In death of mercury poisoning, in addition to routine viscera, bones, teeth, hair and nails should also be preserved for chemical analysis.

**DO'S AND DON'TS**

Author has told to follow the Do's and Don'ts suggested in the chapter of vatarakta (gout) in the cases of mercury poisoning<sup>10</sup>. In vatarakta chikithsa it said that, for initial stage one should get external therapies like abhyanga (oil massage), abhyanjana (bathing) etc. When the disease is serious, one should take treatment by snehapana (taking oily eatables), asthapana basti (decoction enema), virechana (purgation) and raktamokshana (bloodletting) therapy. Generally, abhyanga (oil massage) of Satadhauta Ghritamand abhyanjana (bathing) with milk of aja (sheep) is useful in such cases. Other useful edibles in this case include yava (barley), shashtika and other varieties of rice, goduma (wheat), mudga (kidney beans), milks of aja (goat), mahisha (buffalo) and gow (cow) and non-vegetable preparations prepared out of the meats of lava, tittira and other varieties of birds. Also good are the leafy vegetables involving uopodika (malabar spinach), kakamachi (*Solanum nigrum* Linn) and the like<sup>11</sup>.

A patient should avoid indulging in divaswapna (daytime sleeping), agnisantapa (exposing to fire), vyayama (exercising), atapa (staying under sun), maithuna (coitus), masha (black gram), kulatta (horse gram), nishpava (flat beans), kshara (alkali) products,

flesh of ambuja (aquatic) and anupadesha (marshy) animals, virudha (taking incompatible eatables), dadhi (yogurt), ikshu (sugarcane), mulaka (radish), madya (alcohol), pinyaka (oil cake), amlakanji (sour drink), katu (pungent), ushna (hot), guru (heavy to digest), abhisyandi (causes obstruction to the channels) and lavanasaktu (salty gruel)<sup>12</sup>.

### Mercury poisoning treatment<sup>13-19</sup>

- Removal of patient from exposure to mercury and promoting elimination of the mercury by bowels and kidneys. The rest of treatment is symptomatic. As with most types of poisoning, the first step is to identify and remove the source of the poison.

Depending on the level of mercury poisoning, treatment may involve decontamination. If your mercury levels reach a certain point, a healthcare professional may have you do chelation therapy. Chelating agents are drugs that remove the metal from your organs and help your body dispose of them.

Other attempts to reduce the amount of mercury in your body and gastrointestinal (GI) tract may be performed. These may involve:

- charcoal
- whole bowel irrigation
- dialysis
- transfusions

Long term, you may need continuing treatment to manage the effects of mercury poisoning, such as neurological effects.

There's no cure for mercury poisoning. The best way to treat mercury poisoning is to limit your exposure to the metal. If you eat a lot of mercury-containing seafood, a doctor may caution you to stop immediately.

If toxicity is linked to your environment or workplace, you might need to take steps to remove yourself from the area to prevent further effects of poisoning.

Fish with the highest levels of mercury can include:

- sharks
- swordfish
- bigeye tuna
- marlin
- tilefish
- king mackerel
- orange roughy

It's also possible to develop mercury poisoning from eating too much seafood, even if the varieties have lower levels of mercury.

Fish and seafood with the lowest mercury levels can include:

anchovies	flounder	scallop
Atlantic croaker	haddock	shrimp
Atlantic mackerel	hake	skate
black sea bass	herring	sole
butterfish	lobster	squid
catfish	mullet	tilapia
Clam	oyster	freshwater trout
Cod	salmon	canned light tuna
crawfish	sardine	whitefish

Fish and seafood with moderate levels of mercury can include:

albacore tuna	grouper	sablefish
bluefish	halibut	snapper
buffalofish	Mahi Mahi	striped bass (ocean)
Carp	monkfish	yellowfin
Chilean sea bass	rockfish	white croaker/ Pacific croaker

### Complications of mercury poisoning

- High amounts of mercury can lead to long-term and sometimes permanent neurological changes. The dangers are especially notable in young children who are still developing.
- Mercury exposure can lead to developmental problems in the brain, which can also affect physical functions such as motor skills. Some children who are exposed to mercury at a young age may develop learning disabilities, according to the Environmental Défense Fund.
- Adults with mercury poisoning may have: permanent brain damage

### DISCUSSION-

#### Medico-legal aspect:

- Accidental poisoning may occur from 1) accidental ingestion of antiseptic solutions containing the perchloride or cyanide, or of antiseptic tablets of the perchloride or iodide 2) soluble salts employed as vaginal douches 3) absorption of mercurial preparations applied to the skin, and 4) intravenous administration of organic mercurial as diuretics.
- In children, accidental poisoning may occur from 1) the use of ammoniated mercury in some bleaching creams, and 2) swallowing the sulphocyanide of mercury stick or tablets, the chief constituent of *Pharoah's serpents*.
- Suicidal and homicidal poisoning is rare. After absorption, mercury passes rapidly to the foetus in utero through the placental circulation and causes abortion.

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