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A review of mercury and its toxicity and safety regarding Agadtantra

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Abstract:

In *Ayurveda* many herbal products were extensively used in classic age in all branches of *Ayurveda*. Metals and mineral preparation also used but they have toxicity. In India, there are many metals such as arsenic, lead, copper, zinc, etc, used in various diseases. *Parada* is also one of them *Parada* is liquid, silvery metal which dissolved other metal and in *Shuddha* form it is used in many herbo-mineral preparation. *Bhasma* is also used as a medicine but in *Ashodhit* form it causes toxicity as maintained in *Rasagranths*.

Shuddh form prepares *Rasayogs* and *Ashodhit* form causes toxicity. This article complies all information regarding *Parada*, appearance, historical view, fatal dose, fatal period, sign, symptoms of its toxicity, management, post-mortom appearance, medico-legal aspects regarding *Agadtantra*.

Key Words: *Parada*, *Parada* Toxicity & Safety, Management, Medico legal aspect

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INTRODUCTION:

Parada is called as *Rasa*. It is the physical essence of *Lord Shiva*. It is one of the pure and auspicious metal having extensive healing properties, spiritual and religious importance also. In ayurveda there is branch called as *Rasashastra* where minerals and metals are used to prepare herbo-mineral combination all among that *Parada* got maximum importance. In *Rasa Ratna Sammucchay* states that “*Siddhe Rase Karishyami*”. *Parada* in its *Ashodhita* form causes many symptoms such as vomiting, belching, *Kushta*, boils but in *Shodhita* form it works excellent in many disease like hyper tension, asthma, in sexual ability. Most of the medicine prepared from *Parada* after its *Samanya* and *Vishesh Shodhan*. It is considered that *Parada* is *Shiva Veerya*. According to reference available in *Rasa* classical text, initially *Parada* was used for *Lohavad* (a process of converting lower material into higher one), but as time passed it used for *Dehavad* (treating diseases) was brought into picture and was successfully seen thus evolved its used into treatment. The form of *Parada* used indicates its toxicity and utility. In *Rasashastra* maximum time, *Parada* used alongwith sulphur thus forms *Parada Sulphide* which is safest.

MATERIALS AND METHODS**Ayurvedic View Of Parada:**

- Sanskrit – *Parada*
- Latin – Hydrargyrum (Hg)

This *Parada* of 5 types viz-viz *Rasa*, *Rasendra*, *Suta*, *Parada*, *Mishrak*

Ayurvedic and therapeutic Properties of Parada:

- *Rasa* - *Shadarasa*
- *Virya* - *Ushna*
- *Vipaka* - *Madhura*
- *Guna* - *Snigdha*, *Sara*, *Guru*
- *Prabhav* - *Yogwahi*
- *Vyadhi Prabhav* - *Rasayan*, *Amruta*, *Kushtahar*, *Sarvaroghar*, *Vatroggar*

- *Karma* - *Yogwahi*, *Rasayana*, *Balya*, *Vrishya*

Parada Doshas:

There are mainly 3 types of doshas.

1. *Naisargik* - *Visha*, *Vanhi*, *Mala*
2. *Yogika* - *Naga*, *Vanga*
3. *Aupadhik* - *Parpati*, *Patani*, *Bhedi*, *Dravi*, *Malakari*, *Andhakari*, *Dhwankshi*

Parada and its toxicity are very well known to ayurveda from *Nagarjun Kala*. Vomiting, Belching, Restlessness, Excessive thirst, *Kushta* (leprosy), Boils, Increase body temperature, Death. These are some long term hazards *Parada Yog* are already mentioned in *Rasagranthas*.

Modern View: ⁽²⁾

Mercury was found in Egyptian tomb from 1500 BC. This is available in three forms i.e.

1. Elemental
2. Inorganic
3. Organic

Mercury exposures occur chiefly through inhalation via occupational and dental amalgam ⁽³⁾.

Action: ⁽⁴⁾

1. Mercury binds with sulfhydryl groups resulting in enzyme inhibition & pathological alteration of cellular membranes.
2. Elemental mercury & methyl mercury are toxic to the CNS. In CNS mercury acts mainly upon cerebellum, temporal lobe, basal ganglia and corpus callosum.
3. Metallic mercury vapour is also pulmonary irritant. Acute exposure to elemental mercury vapour may produce corrosive bronchitis with fever, chills, dyspnoea leads to pulmonary oedema and fibrosis. Inorganic mercuric salts are

corrosive to the skin, eye, GIT and nephrotoxic.

Organic forms causes contact dermatitis.

Absorption And Excretion: ⁽⁴⁾

It is absorbed through GIT & respiratory tract. After absorption mercury get deposited in all tissue, liver, kidneys, spleen and bones inhalation absorption in brain. It is excreted through kidney via urine, liver via bile, colonic mucous membrane via faeces.

Acute Poisoning: ⁽⁴⁾

Signs and Symptoms:

First Phase: Acrid metallic taste and feeling of constriction in throat, hoarseness of voice, mouth, tongue and faeces become corroded and swollen and appears grayish white, burning sensation from mouth to stomach, nausea, vomiting sometime associated with blood. This is followed by diarrhea with blood stained stools and tenesmus. Circulatory collapse occurred soon. Inhalation of fumes produces nervous symptoms. E.g. Ataxia, restriction of visual field, paresis and delirium.

Second Phase:

If the patient survives, second phase begins in one to 3 days. Glossitis and gingivitis appear within 24 to 36 hours. Severe infection, loosening of teeth and necrosis of the jaw occur on 2 to 3 days renal tubules shows necrosis and produce transit polyuria, albuminuria, cylindruria, uraemia and acidosis. Recovery may occurs within 10 to 14 days. After many days membranous colitis develops and produces dysentery.

Specific Features / Diseases:

Kawasaki Disease ⁽⁴⁾

Signs of first stage includes high fever (above 104 deg. F), rash / peeling of skin, swelling and redness in hands and bottoms of feet, red eyes, swollen glands especially neck, swollen, bright red **strawberry** tongue.

In second stage symptoms like joint pain, belly pain, stomach trouble such as diarrhea and vomiting occurred.

➤ **Fatal Dose:** ⁽⁴⁾

- 1-4 gms Mercuric Chloride
- 10 –60 mg/kg methyl mercury
- 10 mg/m³ of mercury vapor

➤ **Fatal Period:** ⁽⁴⁾ 3 – 5 days

Diagnosis: ⁽⁴⁾

Acute mercury poisoning can be detected by measuring blood levels, whereas urine and hair analysis help confirming chronic exposure. Urine and blood mercury levels assessed by atomic absorption spectrophotometer. Mercury concentration of hair are best assessed by neutron activation.

Treatment: ⁽⁴⁾

- In case of inhalation immediately removed the source of exposure, O₂ given and observed for development of acute pneumonitis & pulmonary oedema.
- Gives white eggs, milk and animal charcoal to precipitate the mercury.
- Gastric lavage with 250 ml of 5% sodium formaldehyde sulfoxinate about 100ml of this solution is left in the stomach.
- Cathartics should not be given but whole bowel irrigation may be beneficial.
- Penicillamine is used for less severe mercury vapour and inorganic mercury poisoning. It is given orally in a dose of 100mg/kg 6 hourly for 5 days - in children & 250 mg/kg 6hrly for 5 days - in adults.
- BAL is traditional chelator of choice 3-5 mg/kg IM every 4 hourly for 2 days then 12 hourly for 7 days.

- Penicillamine and BAL in combination should not be used as it causes formation of toxic compound.
- Ca-EDTA should not be used as it is nephrotoxic with mercury.
- Urine must be kept alkaline.
- Hemodialysis may be required in case of renal failure.
- Maintain electrolyte balance and symptomatic treatment

Postmortem Findings: ⁽³⁾

- GIT - mucosa inflamed, congestion, coagulation & grayish corrosion ulceration / necrosis of large intestine may be seen.
- Renal—glomerulonephritis or glomerular degeneration may be seen.
- Liver—congested & shows cloudy swelling or fatty change.
- Heart—fatty degeneration and sub endocardial hemorrhage.

Chronic Poisoning (Hydrargyris): ⁽³⁾

This may result from:

1. Continuous accidental absorption by the worker
2. Excessive therapeutic use
3. Recovery from a large dose
4. If ointment is used as external application for a long time

Signs And Symptoms: ⁽³⁾

Symptoms Like Salivation, inflammation of gums and occasionally a blue line at their junction with teeth, gastrointestinal disturbance, anaemia, anorexia, loss of weight and chronic inflammation of kidney with progressive uraemia.

Special Features / Disease:

- **Danbury Tremors:**⁽⁴⁾ Tremors occurs first in the hands then progress to lips and tongue and finally involve arms and legs. Tremors is moderately coarse and jerky movement.
- **Hatter's Shakes:** ⁽⁴⁾ The advanced conditions of tremors are called as a hatters or glass blower

shakes. They are common in persons working in glass blowing and hat industry. The patient becomes unable to trace himself.

- **Concussia Tremors:** ⁽⁴⁾ This is most severe condition of tremor that patient is unable to do daily activity and no movement.

- **Mercurial Erethism:** ⁽⁴⁾ Seen in the person's working in with mercury in mirror manufacturing firms. This term is used to refer to psychological effect of Mercury toxicity. These include anxiety, depression, shyness, timidity, irritability, loss of confidence, mental depression, delusions and hallucinations or suicidal melan cholia or manic depressive psychosis, emotional instability loss of memory and insomnia.

- **Mercurialentis:** ⁽⁴⁾ Is a peculiar eye change due to exposure to the vapor of mercury. It is due to brownish deposit of mercury through the cornea on anterior lens capsule. It is bilateral and no effect on visual activities.

- **Acrodynia or Pink Disease:** ⁽⁴⁾ Characterize by a generalized body rash is thought to be an idiosyncratic hypersensitivity reaction particularly seen in children. This can be caused by chronic mercury exposure in any form. The onset is insidious with anorexia, insomnia, sweating, skin rash and photophobia, hands and feet become puffy, pinkish, painful, parasthetic with peeling of skin, teeth may be shed.

- **Minimata Disease:**⁽⁴⁾ It is a type of organic mercurial poisoning due to eating of fish poisoned by mercury. This disease occurred as a disaster in Japan in 1956 by eating contaminated fish from mini-mata bay.

Treatment: ⁽⁴⁾

- Removal of patient from exposure
- Demulcents

- Saline Purgative
- Oral Hygiene
- Chelation Therapy: D- Penicillamine / BAL / DMPS / DMSA can be used.

Post Mortem Finding:

1. **External:** Erosion of oral mucosa, gum of lower jaw show blue line pigmentation deposition and loosening of teeth.
2. **Internal:** Inorganic mercury poisoning may cause cerebral infraction, pneumonia, renal cortical necrosis, disseminated intravascular coagulopathy.

Medico Legal Aspect: ⁽⁵⁾

1. Mercury used as a Homicidal and suicidal poisoning is rare.
2. Accidental ingestion of mercury may occur from broken thermometer.
3. Accidental ingestion may occur from antiseptic solution containing mercury chloride.
4. Sometimes it is introduced in vagina as a contraceptive or for producing abortion.
5. Intravenous administration of organic mercurial's such as diuretics.

DISCUSSION:

The toxicity of mercury (acute & chronic) has been increased all over world including India. The main sources of exposure of mercury are industrial process; elemental mercury source & ayurveda drug manufacturing contain mercury which causes emission of mercury?. It may be poorer mercury in metallic state not produced toxicity but the toxic compounds like Hg, HgO, HgCl₂, HgI₂ produces toxicity in human being. Acute toxicity causes constriction and burning of food passage, vomiting, diarrhea and circulatory collapsed. Later on glossitis, gingivitis, uraemia and acidosis kawasaki feature appears as special symptom. Acute poisoning is detected by mercury levels in blood. After detection treatment as gastric lavage with 5% sodium formaldehyde sulfoxinate, protein diet and chelating therapy with BAL & Penicillamine given.

Danbury tremers, Hatter's shake, concussia tremers, mercurial Erethism, Mercurialentis, Acrodynia, Minimata are the specific signs of chronic cumulative toxicity of mercury while symptoms like teeth blue line, gastrointestinal disturbance, Anemia, Anorexia, uremia are the nonspecific signs that found. Confirmation done by evaluating the mercury level in hair, blood and urine. After confirmation patient should be subjected to induce emesis, purgation and chelation therapy with D-Penicillamine/BAL/DMPS/DMSA.

In post mortem of Acute poisoning GIT inflammation, congestion, coagulation and necrosis of large intestine is seen. Glomerulonephritis in kidneys, congestion in liver and endocardial hemorrhage found in heart. While in chronic poisoning erosion of oral mucosa, Blue line pigmentation on teeth found externally and cerebral infraction, pneumonia, renal cortical necrosis observed internally.

CONCLUSION:

Parada or mercury is a heavy liquid metal which is found in combined form. The minute part of mercury is consumed by everyone as a medicine but when this mercury is consumed in impure form it causes many disease as we mentioned above but various *Sanskar (Ashta, Astadasha)* conducted on it render its poison less and hence used in various Ayurvedic preparations. However many uses of mercury face out by modern scientist and are under review.

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