

# Silver Toxicity Experienced in the Use of Silver Preparations for Medical Therapy

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Over many centuries, silver preparations have been used to treat disease—so much so that some silver treatments have taken on almost a folklore status. In the early 20th century, silver in various forms became particularly popular amongst so-called holistic healers, e.g., naturopaths. Then, in the latter half of the century, traditionally trained allopathic physicians also became aware of its efficacy in certain cases.

In their earliest usage, silver-based remedies were prepared in the form of silver salts, e.g., silver nitrate and silver acetate. Later, non-salt preparations have included silver sulfadiazine and colloidal silver. All of these remedies have been used primarily to treat infectious conditions.

Generally, the silver salt remedies have shown limited effect, usually requiring relatively high doses to achieve any effect. High dosage of such silver salts—especially after regular, long-term use—has produced reportable cases of silver toxicity, known as argyria. On the other hand, silver colloid preparations are not associated with any reportable toxicity.

Argyria is characterized as a permanent ashen-gray (bluish) discoloration of the skin, conjunctival sclerae, and internal organs resulting from long-continued use of silver salts—without any otherwise notable adverse effects on general metabolic health. Today, it is difficult to find any reference to argyria in any standard medical textbook, i.e., internal medicine or pathology. Modern academic medicine seems to have relegated argyria to the status of a medical historical oddity—clinically experienced as infrequently as diphtheria, previously a scourge of the preantibiotic era.

On the other hand, another form of silver combined with an antibiotic has proven itself to be particularly efficacious—i.e., highly therapeutically effective with very low risk of deleterious side effects. Over the last five decades, most authorities have come to consider silver sulfadiazine (e.g., Silvadene) as an agent of first choice for the prevention of infection of burns. This topical drug inhibits the *in vitro* growth of nearly all pathogenic bacteria and fungi—including species resistant to sulfonamides. (1)

Silver is slowly released from this compound preparation in concentrations that are toxic to the microorganisms. Very little silver is absorbed, whereas the sulfadiazine is readily absorbed, reaching measurable plasma levels.

Adverse reactions to silver sulfadiazine have been infrequently reported as being relatively minor, e.g., rash and itching. It has not been determined whether these adverse reactions are subsequent to exposure to the silver or the sulfadiazine. It is most likely to be the latter.

Parallel to the development of silver sulfadiazine, the use of silver suspended in a protein colloidal solution also became popular over the last century. The naturopaths have been particularly excited about this preparation. However, the efficacy of these protein colloidal preparations often has been questioned—although the incidence of any reported toxicity has been minimal, so has its effectiveness.

More recently, however, the use of low concentration, i.e., <50 ppm, non-proteinaceous silver colloids, such as Peaceful Mountain Sinus Spray (PMSS), have been found to be tremendously effective against localized cutaneous and upper respiratory infections. The levels of this non-proteinaceous silver colloid required to achieve satisfactory antimicrobial action are 100 times lower than that of the previously used silver salts or protein colloids. There has been no reported toxicity or adverse events linked to the use of these pure silver non-proteinaceous colloids.

### **Absorption and retention:**

Silver may be absorbed through the lungs after inhalation, the gastrointestinal tract after ingestion, or directly through the epidermis after contact with liquids, solids, or gases containing silver or its compounds. Absorption rates vary for the various forms of elemental silver and silver compounds. Silver salts, especially in the form of large particle salt powder, appear to be absorbed relatively readily. Studies evaluating the therapeutic uses in humans and the effects of occupational exposure indicate that silver is significantly less readily absorbed after ingestion or inhalation when in the colloidal form (2, 3, 4).

Absorption through the gastrointestinal tract can vary widely. This is a function of the form of the silver as well as species transit time, which is an inverse function, e.g., the absorption rate is lower with faster transit times. Transit times range from about 8 hours in rats and mice to 24 hours in dogs and primates (5). One could, therefore, expect more uptake from herbivores with their relatively long intestinal tracts and less from carnivores with their proportionally shorter intestines.

In a study by Scott and Hamilton who fed silver to rats through a stomach tube, they recorded that 99% was eliminated through the feces and 0.18% was eliminated through the urine in 4 days; 0.82% was retained. (6) Other studies have placed retention in larger animals at between 10 and 1% after 2 days.

Whatever the chemical form or method of silver introduction, whatever amount that is absorbed enters the bloodstream from which most is removed by the liver

and sent to the bile for excretion. After a period of time has elapsed allowing for distribution, any retained silver is equally distributed through all organs regardless of the route of uptake.

Large particle silver salt powder ingestion seems to be associated with most of the cases of argyria, where large amounts of silver have been retained in humans. In cases where argyria have occurred, the total body burden has been estimated at between 20 to 90 g. This amount of silver is contained in roughly 100,000 bottles of Peaceful Mountain Sinus Spray. To achieve such retention, 100,000 bottles would have to be ingested within one week.

More data on absorption (including parenteral) and retention are available on request.

### **Sample case reports of argyria**

Case 1. This report described an experimental study of the toxicity of silver salt. Rats were allowed to drink water a silver salt for 500 days. The water was 1000 ppm silver salt as this was determined by earlier investigation to not reduce longevity. Although this researcher chronicled the internal discoloration of organs after this intense ingestion of silver water—thus reporting an animal model of argyria—he did not see fit to determine or estimate the total silver intake. (7)

- If one were to assume that a human drinks approximately 16 oz. of water per day, the above intake would equivalent to a human intake of 0.473 g/day. This would be equivalent to an extremely low level of nonproteinaceous silver colloid exposure using PMSS.

Case 2. This report described a controlled study of the use of an anti-smoking chewing gum containing silver acetate, asking if this treatment risked creating elevated silver concentrations in the serum and tissues and risked causing clinical signs of argyria. (8)

- The administered amount of silver was estimated at less than 3.2g over a 3-month period. This is equivalent to 4000 bottles of PMSS. This is equivalent to 44 bottles of PMSS/day.
- Although serum silver levels were slightly elevated during the study, they were statistically normal within a few months after study completion. No signs of argyria were noted.

**note:** The silver content of Peaceful Mountain Sinus Spray is 20 ppm or 20 micrograms/ml. Each spray yields 100 microliters or 2 micrograms. One spray up each nostril each hour for 12 hours would deliver 48 micrograms. This is the normal dose during a period of sinus distress or the onset of a cold.

Case 3. This report described a patient who used an anti-smoking remedy containing silver acetate and experienced argyria. Normally, the total body silver is approximately 0.5 micrograms/gram. This patient was estimated to have had a total body silver content of approximately 6.4 grams/gram. This silver content was approximately 8000 times the normal value. (9)

- In order to achieve this body burden by using PMSS, one would have to consume 47,058 bottles, costing roughly \$560,000.
- With the estimated normal dietary intake of 50 ug/day, one would expect to have a normal accumulation of 0.22 g by age 70 years.
- Using established absorption and retention rates, at a usage of *12 times per day for 70 years*, a patient would accumulate approximately 0.21 g of silver.

Case 4. This report described a patient who used topical silver nitrate for 5 years as a treatment for a skin condition. In the course of an unrelated stomach surgery, the surgeon noted the increased pigmentation of the internal organs—evidence of argyria. The report noted that the "minimum oral dosage ingested to yield systemic argyria has been estimated to be 25 to 30 gm over a six-month period." (10)

- This is equivalent to more than 4200 bottles of Peaceful Mountain Sinus Spray per month.
- Similarly, it could be considered 10,000 times the normal dose of PMSS.

Case 5. This report described a patient with uniformly silver-blue discoloration of all fingernails, with deeper coloring over the lunulae. The nail bed changes resulted from the uncontrolled ingestion of a silver containing granular powder for an undisclosed use. The total silver intake was over 15 g. The only other sign of argyria was a barely perceptible greyish discoloration over the cheeks and the sclerae. (11)

- In order to match this patient's intake of 15 g in 3 years one would have to consume 17 bottles of PMSS per day. That would be a \$200/day habit.

Case 6. This report described a patient with argyria secondary to the prolonged use of nasal drops containing mild silver protein. This patient used silver-containing nose drops every night for 35 years. The drops were 1% msp and, assuming two drops per nostril per night, and they delivered an estimated total intake of 25.5 g. (12)

- The drops were 1% msp, which is to say 10,000 ppm. If one were to use PMSS 12 times a day, the accumulated dose would be 40 times less. It would take 1400 years to accumulate the level of silver that this fellow had.

Much more data on toxicity studies are available on request.

## EPA Standards:

According to the EPA, silver is relatively non-toxic. It is not listed in the EPA Primary Standards for water quality. It is listed only in the Secondary Standards, which regulate contaminants that cause offensive taste, odor, color, corrosion, foaming, or staining. The concentration limit is called the secondary maximum contaminant level (SMCL). Secondary standards are not enforced; they are guidelines for water treatment plant operators and state governments attempting to provide communities with the best quality water possible. The Secondary Maximum Contaminant Level for silver is listed as 0.1 mg/L. This is equivalent to 100 ppb or about 100ug /day for one who consumes 4-8 oz glasses of water per day. In comparison, the mean content of silver in milk varies between 27 and 54 ug/L in the US. The average person consumes 10 to 90 ug /day in their food.

The EPA critical dose for 160-pound adult, i.e., the amount that should not be exceeded in daily consumption, is 1.09 mg/day or 1,090 ug/day. The EPA allows the ionic form of silver, Ag<sup>+</sup>, in drinking water at the level of 100 ppb. This is equivalent to .1mg/L. The consumption of 4-8 oz glasses/day is equivalent to 100 ug/day of Ag<sup>+</sup>.

Likewise, the EPA does not consider silver to be a human carcinogen. In fact, their standards for the allowable levels of silver in drinking water would permit a typical human to consume 50 to 100 micrograms per day. Long-term experiments with rats and rabbits indicate that 2.5ug /kg body weight had no detrimental effects. This would equate to roughly 175 ug/day for a 150-pound human.

## Dietary minerals:

One can compare other metals and minerals that are consumed intentionally in common vitamin and mineral supplements. Most of these are consumed in far higher doses than would be received by proper use of the Peaceful Mountain colloidal products.

Element	Atomic weight	Daily Amount per Vitamin Tablet
Magnesium	24.30	100,000 ug/day
Iron	55.85	18,000 ug/day
Zinc	65.38	15,000 ug/day
Copper	63.55	3500 ug/day
Manganese	54.94	3000 ug/day
Molybdenum	95.94	208 ug/day
Chromium	52.00	150 ug/day
Iodine	126.90	150 ug/day
<b>Silver used in PMSR</b>	<b>107.87</b>	<b>50 ug/day when used hourly</b>
Tin	118.69	13 ug/day
Nickel	58.70	6.5 ug/day

## References

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