

The Long History of Silver in Health and Healing

Scientific Characteristics

Silver (Ag) is in the periodic table of elements as number 47, with an atomic weight of 107.868, a melting point of 960.8 °C, a boiling point of 2,212 °C, a specific gravity of 10.50, and a valence of 1, 2. The loss of one valence electron gives rise to the positive silver ion. Silver is the most electrically conductive of all elements, which is a bias factor in determining accurate ppm measurements.

Silver is one of the so-called 'heavy metals', along with lead, mercury, cadmium, and gold. Surprisingly, unlike its heavy metal cousins, silver is non-toxic to humans and animals. And unlike the other heavy metals, silver has a long history of successful medical and public health use dating back over 5000 years. Medical uses for silver include infection treatment, dentistry, and surgical implants. Its malleability, conductive and germ fighting characteristics make it ideal for these purposes.

Silver has been used to speed wound healing, treat infections, purify water and preserve beverages. For example, the ancient Macedonians covered wounds with silver plates to speed healing⁽¹⁾, and N.R. Thompson has noted, "The germicidal properties of silver, although not recognized as such, have been utilized since the times of the ancient Mediterranean and Asiatic cultures, references being made to the use of silver vessels to prevent spoilage of beverages and silver foil or plates in the surgical treatment of wounds and broken bones."⁽²⁾

The Beginning (3,000 BC)

Silver jewelry was found in modern day burial excavations of the ancient Sumerian city of Ur. The first major sources of mined silver were the mines around Anatolia, which is in the area of modern day Turkey, and they originate from this time. The Chaldeans were the first culture to extract silver from other ores around 2500 BC.

1,000 BC

The writings of Herodotus, the Greek philosopher and historian, date back to before the birth of Christ, and offer some insights to the use of silver as a healing agent. Herodotus, called the "Father of History", is one of the prime sources for information known about the fall of Babylon. He lived a century after the time of Daniel and traveled widely in the East. "Histories" tells of the campaign of Persia's King Cyrus against Babylon. The details include the fact that no Persian king, including Cyrus, would drink the water of any stream other than the Choaspes (Karkheh), a river that flows past the Persian capital of Susa. Wherever the king went, a long train of four-wheeled mule wagons followed him transporting silver jars filled with boiled water from the river waters. The water would keep fresh for years during the long campaigns.

900 BC

Beginning around this time, the Larium mines near Athens became the leading silver-producing mines for the Mediterranean, North Africa, Asia Minor and the Middle East; they continued as such for the next 1,000 years. Recognizing the value of silver vessels in water purification and storage, Greek craftsmen produced silver vessels for use on ships and for trade with other countries.

200 BC

Chinese immigrants in Korea brought their silversmithing techniques to Korea. From Korea, silver use spread to Japan, but never really caught on. In Rome, people began using silver in coins, drinking vessels, and other household items.

1st Century AD

The Indus culture of India produced silver drinking vessels similar to Hellenistic types.

600 AD

Silver work became very important in China during the T'ang dynasty, which lasted from 618-907 AD. Before this time silver was very rare in China.

900 AD

Fine silver techniques are said to have reached the Oaxaca region of Mexico during this period.

1,000 AD

The Repoussé technique became common during China's Sung Dynasty. Spanish mines began to be important sources of silver around this time, as well as those in Eastern Europe (Germany, Austria-Hungary and others).

16th Century

The Spanish who conquered the Mexican, Panamanian, Andean and Costa Rican Indians in the new world during this century found that the skills of the silversmiths were comparable to their own in their level of technique and artistry. European exploitation of the new world silver began in Bolivia; Bolivia, Peru and Mexico grew to produce nearly 85 percent of the world's silver between 1500 and 1800.

17th century

Native American tribes in New York (the Seneca, Iroquois, Cayuga and the Onondaga) began turning European silver coins into jewelry at the beginning of the 17th century. India's production of silver vessels for English royalty increased, having mastered the gold and silver techniques of cold hammering, embossing, annealing, false filigree and false granulation.

18th century

In the 1700s, several physicians discovered the antibacterial (anti-germ) qualities of silver and applied them to their practice of medicine. They used silver nitrate successfully in the treatment of skin ulcers, compound fractures and suppurating (draining puss) wounds.

19th century

Silver electroplating was invented. Tiffany and Company began producing silverware in New York in the mid 1850s. During this time the Navajo tribes of the American Southwest began working silver (learned from Mexican artists) and had passed their skills onto the Zuni tribes by the 1870s. Silver gained wide usage in tribal medicine. In 1881, Carl Crede pioneered the installation of dilute silver nitrate in the eye of neonates to prevent gonorrheal ophthalmia, a technique which has been in widespread use ever since. Von Naegeli and others in 1893 realized that the antibacterial effects of silver were primarily due to the silver ion. He coined the term oligodynamic to mean that a small amount of silver is released from the metallic surface when placed in contact with liquids. The medical use of silver expands extensively throughout China during this period.

20th Century

The modern era of silver usage actually began in 1893, when C. Von Nageli reported the first systematic investigation into the lethal effects of metals [especially silver] towards bacteria and lower life forms. "To primitive life forms oligodynamic silver is as toxic as the most powerful chemical disinfectants and this, coupled with its relative harmlessness to [animal] life, gives it great potential as a disinfectant.... The term 'oligodynamic' silver [refers to] solutions in which the metal ion concentration is many orders of magnitude below that which would be lethal to higher life forms."⁽²⁾

From 1900 to the beginning of the modern antibiotic era - circa 1940 with the introduction of sulfa drugs - silver was one of the mainstays of medical practice in Europe and America. Various forms of silver were used to treat literally hundreds of ailments: lung infections such as pneumonia, tuberculosis and pleurisy ⁽³⁾; sexual diseases such as gonorrhea and syphilis ⁽⁴⁾; skin conditions such as cuts, wounds, leg ulcers, pustular eczema, impetigo and boils ⁽⁴⁾; acute meningitis and epidemic cerebro-spinal meningitis ⁽³⁾; infectious diseases such as Mediterranean fever, erysipelas, cystitis, typhus, typhoid fever, and tonsillitis ⁽³⁾; eye disorders such as dacryocystitis, corneal ulcers, conjunctivitis and blepharitis ⁽⁵⁾; and various forms of septicemia, including puerperal fever, peritonitis and post-abortion septicemia. ^(3, 6) (This list does not even begin to exhaust the published medical uses for silver in Europe and America, 1900-1940).

In 1939 Hill and Pillsbury listed 94 different proprietary silver preparations in use up to that time. ⁽⁷⁾ However, with the coming of antibiotics, the so-called 'miracle drugs', silver rapidly fell into disuse and was replaced first by sulfa drugs, then penicillin (post WWII), and since then by hundreds of specialized antibiotics.

Under the onslaught of antibiotic warfare, the second half of the 20th century witnessed the seeming eradication, or at least control, of most of mankind's ancient plague scourges. Indeed, some major infectious diseases have been virtually wiped out in the modern world, (supposedly) thanks to antibiotics. By the late 1980's, antibiotics had so succeeded in controlling/eradicating most germ diseases, that medical researchers and pharmaceutical companies seriously slowed research into new antibiotics, thinking that there was no longer any need for (and not nearly enough 'big bucks' to be made from) newer and better antibiotics. Yet by the 1990's the picture began to change again.

At the turn of the century, Dr. William Halstead, one of the founding fathers of modern surgery, advocated the use of silver foil dressings for wounds. These dressings were used extensively until just after World War II and were listed in the Physician's Desk Reference until 1955, when the use of antibiotics became widespread.

In the early 1970's, Drs. Becker, Marino and Spadaro of the Veterans Administration Hospital in Syracuse, New York pioneered the study of silver-coated fabrics for the treatment of complex bone infections. Having studied with Dr. Becker, Dr. A. B. Flick began developing broader clinical applications for silver nylon fabrics in partnership with Dr. Becker during his Orthopedic Surgery residency training at the University of Vermont. Dr. Flick subsequently entered private practice and continued his research independently.

During roughly the same time, three other university centered research teams also investigated the wound healing properties of silver plated fabrics with the application of an electrical potential. In 1985, Dr. Alvarez of the Department of Dermatology at the University of Miami studied the effect of electrically activated silver-coated fabrics on an animal model of partial thickness skin wounds in pigs. Dr. Marino and Dr. Albright of the Department of Orthopedic Surgery, Louisiana State University, 1983 - 1986, studied the effect of electrically activated silver plated fabrics on chronic bone infections in humans. Some common (and dangerous) germs such as Staph aureus (found especially in hospitals) are now known to be resistant to all but one antibiotic - vancomycin - and soon are expected to be vancomycin-resistant too. ^(8,9) "In 1992, 13,300 hospital patients died [in the U.S.] of bacterial infections that resisted the antibiotics fired at them, says the CDC." ⁽⁸⁾

In the early 1990's, dozens of colloidal silver Ag(e) manufactures began to spring up across the country, selling their wares in various alternative health markets. With the arrival of the Internet, hundreds of colloidal silver, silver proteins, and silver salts manufactures appeared. Soon, complaints began to pour in to the FDA about poor product quality and blatant sales fraud. By 1996 the FDA acted with a heavy-hand to curtail the complaints and squash the newly emerging industry. They did this by declaring drug products containing colloidal silver or silver salts as 'not recognized as safe and effective and misbranded' even though a preponderance of historical data proved otherwise.⁽¹⁰⁾ The widespread believe is that the agency may have acted under pressure from the lucrative drug industry that was trying to protect profits. It is interesting to note that far more dangerous products, such as tobacco and others, were not be regulated in any way by the FDA. Heavily influenced by political and special interests pressures, the FDA's effectiveness was only marginal in that it continues to allow dangerous drugs on the market that caused massive harm to the public and allowed doctors

wide latitude in prescribing powerful usage-specific drugs for untested and unapproved applications.

In typical bureaucratic fashion, the FDA overreacted by attempting to squash access to any information about silver products. Acting as the federal word police, companies were often selected for prosecution solely based on the use of certain words. Today, there is an extensive set of so-called “Trigger Words” that are guaranteed to bring down the wrath of the FDA. The FTC quickly joined in to protect their turf in the area of product advertising claims with their own version of federally approved word usage. It is a federal crime to make any ‘non-approved’ claim about the health benefits of any item in the process of selling of that item. Thus, if it is claimed that water is good for health, when attempting to sell water, a federal crime has been committed. Meanwhile, the EPA continues to support the fact that the use of silver is both safe and useful.

21th Century

Within the first few years of the 21st century a ground swell began to appear as more and more people became aware of the benefits of silver. Corruption and healthcare systems failures in government, the drug industry, and the healthcare industry in general has caused many people to attempt to take back control of their own health. Home production of colloidal silver is one of these self-care efforts. Colloidal silver remains as one of the few ways people have to protect themselves from dangerous infections.

Thanks to high increase in global air travel, ecology-tourism to exotic third-world forests and islands, and massive migration of third-world people to Europe and America, hosts of exotic diseases once isolated to small areas of the planet are now showing up all over. ^(8,9) Malaria is once again returning to the US. The exotic and deadly Ebola virus has broken out in a lab in Maryland. Shigella (which causes dysentery) was practically unheard of in America before 1990, but it is now being spread from contaminated fruits and vegetables imported into the US under NAFTA and is now routinely seen at clinics in California.

Perhaps the scariest scenario that may present a need for a powerful, broad-spectrum antimicrobial such as silver is the late 1990's threat of 'bioterrorism.' It is now widely expected by biowarfare and terrorism experts that, whether due to small groups of terrorists, or as a form of warfare by 'rogue'/totalitarian nations such as China, Iran, Libya, N. Korea, Syria, or Russia, it is only a matter of time before 'germ warfare' is unleashed in Europe or America. ⁽¹⁰⁾ And if the supergerms released have been produced in sophisticated biowarfare labs, they will probably have been genetically altered to make them resistant to the antibiotics normally used to treat that species of germ - e.g. tetracycline/doxycycline normally used to treat Anthrax (the number 1 favorite of 'biowarfare warriors' world-wide). ⁽¹⁰⁾ It is interesting to note that silver - both in liquid solution and as an airborne-aerosol - has been known since 1887 to be extremely toxic to Anthrax spores. ^(1,10,11,12) It is widely reported in the medical literature on silver that various forms of silver, often at surprisingly low concentrations, routinely kills germs that are known to be antibiotic-resistant. ^(11,13,19,20)

Most antibiotics have an optimal effectiveness against only a few different disease germs; even broad-spectrum antibiotics may kill only 10-20 different types of bacteria. Also, most antibiotics that kill bacteria will not kill fungus/yeasts, protozoal parasites or viruses; antifungal

antibiotics will not kill bacteria, viruses, parasites, etc., and virtually all known viruses are immune to virtually all known antibiotics.

Silver is unique among antimicrobial agents in its broad spectrum of action. It has been claimed to kill some 650 different disease organisms. ⁽¹³⁾ Unlike antibiotics, silver is an 'equal opportunity destroyer' - it doesn't discriminate, but effectively kills germs of all major types: gram-positive and gram-negative bacteria, spore-forming bacteria, fungus/yeasts, viruses and protozoal parasites. Silver sulfadiazine (Silvadene[®]), used almost universally in hospitals to prevent serious burn infections ⁽¹¹⁾, kills dozens of different bacteria ^(11, 14, 16); it also kills 95% of 72 strains of herpesvirus ⁽¹⁵⁾, as well as the protozoal parasite *Plasmodium berghei* (malaria). ⁽¹⁷⁾ Silvadene[®] also kills various yeasts, including several *Aspergillus* varieties, *Mucor pusillus*, *Rhizopus nigricans* and 50 different clinical isolates of *Candida albicans*. ⁽¹⁸⁾

Electrically-generated colloidal silver Ag(e) has been shown to kill dozens of bacteria, including *Providencia stuartii*, a germ already resistant in the 1970's to all antibiotics except amikacin ⁽¹⁹⁾, as well as two strains of *Enterobacter cloacae* that were isolated from burn patients and were relatively resistant even to Silvadene[®]. ⁽²⁰⁾ Colloidal silver has also proven adept at killing various yeast/fungus species at very low silver concentrations, including *Candida albicans*, *C. parapsilosis*, *C. tropicalis*, *C. pseudotropicalis*, *Torulopsis glabrata* and *Aspergillus niger*. ^(20, 23)

Colloidal silver has been shown to kill cysts of the common water-borne protozoal parasite *Entamoeba histolytica*. ⁽²²⁾ Colloidal silver has also killed the protozoa *Paramecium* when exposed to 2.2 ppm Silver, as well as the protozoa *Varicella* at 5.9 ppm silver. ⁽¹⁾

Colloidal silver was even effective in killing Poliovirus in swimming pool water, at the extremely low concentration of 0.015mg silver per liter of water (15 parts per billion!). ⁽²¹⁾

The proprietary silver compounds Certisil and Micropur, used to disinfect water, are effective against Bovine Enterovirus, Vacciniavirus (cowpox), Influenza A and Pseudorabies virus. ⁽²¹⁾

In short, as pioneering silver researcher Dr. Henry Margraf has stated, "Silver is the best all round germ-fighter we have." ⁽¹³⁾

Historically, silver was used in 20th Century medicine in a wide variety of forms. It was used as silver salts (e.g. silver nitrate, silver phosphate, silver iodide, etc.) and silver compounds (e.g. silver sulfadiazine, silver arsphenamine, zinc-silver allantoinate). ⁽¹¹⁾ Doctors using silver in the first half of the 20th century typically preferred a colloidal form of silver, either chemically or electrically produced. ^(3, 11) Mild silver protein and strong silver protein (silver combined with proteins) have a broad spectrum of action.

Silver salts never achieved widespread use in medicine for several reasons. As Grier notes, "Water-soluble ionized preparation [i.e. silver salts] are generally corrosive, irritating and astringent." ⁽¹¹⁾ Silver nitrate is notorious for being irritating to tissue and staining everything it touches. ⁽¹³⁾ Also, silver salts are often not as effective as colloidal silver or silver proteins. For example, Simonetti and colleagues tested extremely dilute solutions of electro-colloidal silver Ag(e) and silver nitrate Ag NO₃ against cultures of two bacteria (*E. coli* and *P. aeruginosa*), a yeast (*C. albicans*) and a mold. The levels of silver ion tested were incredibly low: 108 ppb

(0.108mcg/ml) and 10.8ppb (0.0108 mcg/ml). Simonetti et al concluded, “Our experiments showed that the contact antimicrobial activity of Ag(e) was superior to that of AgNO₃ against gram-positive and negative bacteria, *C. albicans*, and a filamentous mycete. Our contact tests confirmed the excellent antibacterial spectrum and the high potency of electrically generated silver demonstrated previously.... Anodic silver ions are very effective agents at low concentrations without any detrimental effect upon normal mammalian cells, and the [low] concentrations needed to inhibit the bacteria in invitro experiments have been confirmed clinical data.” ⁽²³⁾

Silver salts also tend to be more toxic than silver proteins and colloidal silver. Thus, when Hussain et al tested AgNO₃ on fresh human lymphocytes, they found 90% lymphocyte destruction when they were exposed to 50 micromoles silver as AgNO₃ for two hours. Yet when lymphocytes were exposed to 1200 micromoles silver as a silver-cysteine complex, there was no significant impairment of the lymphocytes at a silver dose 24 times greater than the AgNO₃ provided. ⁽²⁴⁾

Both modern science and medical practice in the early 1900's favor the use of either colloidal silver or mild silver protein (strong silver protein contains less silver than mild silver protein, but is generally more irritating to tissue). ⁽¹¹⁾

Electrically prepared colloidal silver Ag(e) is currently available from many sources, in potencies ranging from 3-5 ppm up to 500 ppm. Equally (or more) important than the silver level is the particle size and degree of dispersion. In a liquid colloid, the silver does not actually dissolve in the liquid; rather, it exists as a suspension of microscopic particles floating around in the liquid medium. Properly made Ag(e) should contain particles approximately 0.01 to 0.001 microns in diameter (1 micron = one millionth of a meter, or 4/100,000 inch). At this tiny size, each particle is a cluster of perhaps 5-20 silver atoms, with a positive electrical charge. Because the particles are so tiny (and thus light) and because the charged particles repel and 'bounce off' each other, they can defy gravity and remain suspended in their water medium for months - even years when properly stored (away from light, at room temperature). However, over time the silver particles may gradually absorb onto the walls of the container, gradually lowering the amount of silver in suspension. The most thoroughly dispersed Ag(e) should be yellow in color, as colloid chemist H. Freundlich noted in 1992: “With increasing degree of dispersion the color of silver sols [colloids] changes from gray-green through lilac and red to yellow.” ⁽²⁵⁾ Because each Ag(e) particle contains 5-20 silver ions, the particles act as a time-release mechanism to provide continuous germ-killing silver ion availability, as single silver ions gradually break off from their parent microclusters.

Mild Silver Protein - Pros and Cons

Mild silver protein (MSP) is made by various chemical processes that ultimately create a 19-25% silver content, the remainder being a protein. ⁽¹¹⁾ Like Ag(e), MSP is also made in various potencies from 10 to 500 ppm silver. The protein acts as a stabilizer for the silver particles, preventing them from combining with each other to form ever-larger particles that would gradually settle out of suspension. Thus, the shelf-life of MSP is generally longer than for

Ag(e). The silver protein combination also acts as a time-release mechanism to gradually liberate silver ions.

Safety

A hundred years of published clinical and experimental research has demonstrated silver to be a surprisingly safe substance, unlike its heavy-metal cousins lead, mercury, cadmium and gold. In general, silver salts are more toxic than Ag(e) or mild silver protein, but are still relatively non-toxic. Thus Sollman (1943) observed that silver nitrate in doses of 0.01 [10mg] to 0.1g [100mg] by mouth produces no symptoms and swallowing pieces of [silver nitrate] pencils up to 2.5g is often harmless, but larger quantities cause acute gastritis. These reactions are purely local. From 2 to 30g has caused death within a few hours to a few days; 10g are generally fatal, but the ingestion of 30g has been survived.... For many years silver compounds were considered the most effective agents available for the prevention and treatment of gonorrheal infections.... The silver proteinate, especially of the argyrol type [i.e. mild silver protein], have been used extensively in the treatment of infections of the mucous membranes of the eyes, ears, nose and throat. Thus it has been shown that silver compounds are useful germicides and that effective doses are harmless." ⁽¹²⁾

Writing in the *Lancet* in 1912, physician C.E. MacLeod reported, based upon his widespread clinical use of chemically-produced colloidal silver, "They [silver 'collosols' of 500 ppm strength] may be applied topically, hypodermically, intravenously, or by the mouth, and being non-toxic the dose hypodermically is unlimited, and experimental injections of 1 to 2 c.c. of 500 ppm silver would supply 1/2 to 1mg silver."

French physician B.G. Duhamel reported on the use of Electrargol (an electro-colloidal silver providing 400 ppm silver) also in the *Lancet* in 1912. He stated, "They [Ag(e) preparations] are employed as a rule for the sake of their constitutional effects, for which purpose an injection of from 5 to 20 c.c. [2 to 8 mg silver] is made into muscle or... into the veins.... Similarly, the colloid [silver] products can be injected... into the spinal canal (cerebro-spinal meningitis).... the most remarkable effects follow the intravenous injection of these colloids; indeed in some instances the patients have been rescued from apparently inevitable death.... One point stands out prominently, and that is the absolute innocuousness of these [silver colloids], whether injected into the veins or muscles or into the spinal canal.... the dose is determined solely by the requirements of the case since they are devoid of toxicity."

T.H. Sanderson-Wells, reporting on the successful treatment of a case of puerperal septicemia by injection of "collosol argentum" (a 500 ppm chemical-colloidal silver) noted, "0.20 c.cm. of collosol argentum [=10 mg Silver] produced no untoward effects." ⁽²⁸⁾

Most of the quantitative safety data on silver comes from a large number of animal studies done in the past century. Thus, "Huebner found that with intravenous injection into rabbits the minimum lethal dose of the non-colloidal silver thio-sulfate was 0.01 to 0.03 gram per kilo, while the minimum lethal dose of colloidal silver was 0.065 gram per kilo." ⁽²⁷⁾ This would equate to an injection dose for a 70kg/154 pound human of 4550 mg.

M.S. Wyszor tested high doses of silver sulfadiazine (30% silver) in mice every day for a month. He reported, "Doses of 1,050 mg/kg when administered by oral and subcutaneous routes were not toxic.... No deaths occurred within the two experimental groups ... during the 30-day test period.... At the end of the test period, all the animals were sacrificed and tissue sections sent to the Department of Pathology for analysis. Histological studies showed that there was no obvious pathology in any of the groups receiving silver sulfadiazine for the test period. There was no weight loss in any of the groups and no evidence of behavioral changes. None of the animals exhibited diarrhea." ⁽¹⁷⁾ A 1,050 mg/kg dose of silver sulfadiazine would translate into roughly 22 grams of elemental silver for a 70kg/154 pound person.

Hill and Pillsbury report results of many animal silver toxicity studies in their 1939 book on silver. For example, "Lentz has administered a saturated solution of a silver oxide containing 1.52 grams per liter intravenously in doses as large as 4 c.c. three times daily for a period of three weeks to various animals without producing any apparent toxic effects." ⁽⁷⁾ An equivalent dose for a 70kg human would provide 1190 mg silver daily.

"Gompel and Henri studied the effects of repeated injections of a dilute colloidal silver solution over long periods in guinea pigs and rabbits. Using a solution containing 250 ppm silver applied daily for two months they found that this caused no particular symptoms.⁽⁷⁾ The silver content of the drug was 14.5%.... Hooper and Meyers found that silver arsphenamine did not produce any diffuse kidney lesions and that the... cells of the liver were in all cases well preserved. The majority of the rabbits showed a gradual increase in hemoglobin and red blood cells during the experiment, while the white cell count and the differential cell count remained within normal limits.

It is seen that in spite of the administration of silver arsphenamine in amounts far exceeding that employed clinically [in humans], no significant toxic effects were observed.⁽⁷⁾ The total silver amounts used in this experiment would equate to a minimum of 2304 mg silver to a maximum of 23.98 grams silver for a 70kg human.

It is clear from the studies that silver is a reasonably non-toxic metal for humans especially when taken orally, and it is even fairly non-toxic even when injected, especially at the modest dosage level of 10 mg daily or less. Early 1900's silver injection medical protocols typically provided 1-10 mg silver daily, sometimes more.

Argyria

Given the broad range of silver's efficacy against germs - even antibiotic-resistant ones - and its relatively high degree of safety, one might wonder why silver isn't routinely used by every doctor and hospital in the world today.

Aside from the seemingly cynical reason that the medical-industrial complex would lose revenue (sickness pays, wellness doesn't, and a single pill of a modern 'high-tech' antibiotic typically sells for \$10-20), there is a more legitimate cosmetic reason for caution in silver use: the phenomenon known as argyria. When sufficiently large quantities of silver accumulate in the body, some of it accumulates just beneath the surface of the skin, which may lead to a permanent bluish-gray tinge to the skin.

As Hill and Pillsbury (both Md.'s) note in their massively researched (601 references) 1939 book *Argyria*, "A striking feature of argyria is the absence of any evidence that the deposits of silver produce any significant physiologic disturbance of the involved organs or tissue.... Aside from the pigment deposit, the gross and microscopic appearance of the involved tissues is normal. Argyria is, therefore, of significance only from the standpoint of cosmetic appearance." ⁽⁷⁾

In their chapter on silver in the 1986 Handbook on the Toxicology of Metals, Fowler and Nordberg also remark that, "argyria... is bluish-gray discoloration of the skin.... Although not esthetic, this condition is considered harmless.... a total dose of 1-8 g Silver would be required to induce the condition in a long-term inhalation exposure situation. The dosage required to induce argyria by ingestion seems to be somewhat higher, i.e. between 1 and 30 g of soluble silver salts...." ⁽²⁹⁾

Hill and Pillsbury could only find 239 reported cases of argyria by 1939, in spite of silver's widespread medical and over-the-counter use in America and Europe during the previous 40 years. Only 16 cases occurred from less than one year's chronic use of silver; about half occurred with 3 years or less of chronic silver use; and about half of all cases involved chronic silver use ranging from 3 to 25 years. Where the published information (214 cases) provided data on the silver compound used, 55% (118) of the argyria cases were caused by silver nitrate; 13% (28) were caused by Argyrol, a mild silver protein; 9% (19) were caused by Silver arsphenamine; 6% (13) were caused by Collargol, a chemically produced colloidal silver, and various other products caused the remainder of reported argyria cases (7). In their summary Hill and Pillsbury report that a safe (with respect to argyria) total dose of the intravenous drug silver arsphenamine would be 6 grams (.9 grams silver), while with silver nitrate "the danger of argyria is very slight if the total amount ingested by mouth is below six grams [3.8 grams silver]." ⁽⁷⁾

To put this in perspective: if one assumes that electro-colloidal silver and mild silver protein are equally prone to cause argyria compared to silver nitrate (and they probably are actually less prone to promote argyria), then it would take 11.5 years of daily oral use of two tablespoons of 30 ppm silver to reach the 3.8 gram silver threshold. Thus the risk of developing argyria from occasional use of silver to treat specific infectious conditions must be considered virtually non-existent.

Reducing the Risk

The two simplest methods to reduce argyria risk are:

Do not use silver nitrate (AgNO₃) internally - it's the best reported promoter of argyria.

Use of colloidal silver in moderation.

For example: limiting continuous day-to-day usage to no more than one or two tablespoons of less-than 10 ppm colloidal silver and alternating peak usage periods of one to two months of high usage with equal periods of no usage at all. It is important

to remember that everyone reacts differently, and accommodation must be made for individual characteristics; therefore, consulting a doctor concerning individual medical requirements should be considered.

The dietary supplements, vitamin E, selenium, and NAC (N-acetylcysteine) may also provide significant protection against silver accumulation and thus argyria. Fowler and Nordberg state that "Alexander and Aeseth (1981) reported that rats injected intravenously with silver nitrate excreted silver in the bile mainly bound to a low molecular-weight complex which appeared to be glutathione."⁽²⁹⁾ Glutathione (GSH) is a tripeptide composed of glutamic acid, glycine and cysteine. Based on their study of the protective effect of NAC against various toxic agents, Dawson et al reported: "The protective effect [of NAC] in some cases is due to the free sulfhydryl group which N-acetylcysteine contains, and in other cases it is due to its role as a precursor for cysteine in [GSH] biosynthesis."⁽³⁰⁾

Bergstrom and colleagues remarked that "...oral NAC in fact offers prompt availability of thiol groups needed for [GSH] biosynthesis in the hepatic cells where the need is highest."⁽³¹⁾ Lorber et al stated that "Our in-vitro studies demonstrated that NAC effectively complexes gold, mercury and silver.... Our [clinical] findings suggest that NAC may be a promising and effective treatment of gold [and thus presumably Silver] intoxication.... The use of N-Acetyl cysteine may thus afford better detoxification for... heavy metal poisoning than other available agents in current use."⁽³²⁾ In order to avoid cancelling out the microbicidal effect of silver, it would probably be best to wait until a given course of silver treatment is complete, then begin taking 200-600 mg NAC two or three times daily with meals. This will enhance clearance of any residual silver from the body, thus reducing the risk of argyria.

Historical Uses and Dosage

In the past colloidal silver has been useful in treating virtually any infectious condition; it had widespread usage in the treatment of literally hundreds of infectious conditions from 1900 to 1940. ^(3, 4, 5, 6, 7, 11, 12, 28)

Silver was dropped into the ear several times daily for ear infections. Silver was also snorted into the nostrils from a nasal squirt-bottle for sinus infections or to abort head-colds. A diluted silver solution (5-10 ppm) was dropped into the eyes to treat conjunctivitis or to soothe inflamed, itchy eyes. Silver was swabbed or rubbed (mixed with fresh-squeezed aloe vera gel) onto minor burns, cuts, scrapes, wounds, etc. to prompt healing and prevent heal/infection. Silver was massaged into gums several times daily for dental infections. Silver was useful for treating animal (farm or pet) infections as well; dose was scaled down or up (compared to human weight/dose) depending on the weight of the animal.

Silver has also been used as a water purifier since 1900 or so; since the 1930's, silver has been used to impregnate water filters to kill germs in the water or which might grow in the filter medium. ^(11, 12, 21) The consensus of water treatment experts has been that as little as 0.05 to 0.5 ppm is sufficient to kill most bacteria within several hours. ^(11, 12, 21) Protozoal parasites (Giardia, Entamoeba, Paramecia, etc.) may require higher levels - e.g. 5-30 ppm. ⁽²²⁾ In germicidal applications to purify water of doubtful quality, add 1 to 3 teaspoons of 10-50 ppm silver to a

pint of water; stir thoroughly and let stand for several hours. This is only a very general guideline - increase the silver dosage as required.

Technical Note

Most silver preparations express their silver content in parts-per-million (ppm).

1 ppm = 1 microgram (mcg) silver per cc = 5 mcg silver per teaspoon = 15 mcg silver per tablespoon.

30 ppm = 30 mcg silver per cc = 150 mcg silver per teaspoon = 450 mcg per tablespoon, etc.

References

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