Mercury Toxicity and Systemic Elimination Agents

Dietrich Klinghardt, M.D., Ph.D. and Joseph Mercola, D.O.,

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The Problem

We are seeing a serious rise in the environment of neuro-toxic chemicals and heavy metals. The resultant accumulation of heavy metals in the human body poses significant health risks. Chronic mercury exposure from occupational, environmental, dental amalgam, and contaminated food exposure is a significant threat to public health. A single dental amalgam filling with a surface area of only 0.4 cm^2 is estimated to release as much as 15 micrograms of mercury per day primarily through mechanical wear and evaporation.[1] The average individual has eight amalgam fillings and could absorb up to 120 micrograms of mercury per day from their amalgams. These levels are consistent with reports of 60 micrograms of mercury per day collected in human feces.[2] By way of contrast, estimates of the daily absorption of all forms of mercury from fish and seafood is 2.3 micrograms and from all other foods, air and water is 0.3 micrograms per day.[3]

The mercury vapor from the amalgams is lipid soluble and passes readily through cell membranes and across the blood brain barrier.[4] It is scientifically clear that amalgam mercury transfers to human tissues, accumulates with time, and presents a potential health threat. The scientific evidence is so overwhelming that, in 1994, the United States Public Health Service declared that mercury amalgam exposure was higher than their established minimal risk level standard for the general population. The U.S. Public Health Service and the American Academy of Pediatrics recommendation in July of 1999 to remove the mercury in the vaccines administered in the U.S. also demonstrates the U.S. government's recognition of mercury as a toxic agent.[5]

A "silver" filling, or dental amalgam, is not a true alloy. Amalgams are made up of 50% mercury, which is not, as most dentists believe, locked into the filling. Rather, the mercury escapes continuously during the entire life of the filling in the forms of vapor, ions and abraded particles.[6] Chewing, brushing, and the intake of hot fluids stimulates this release.[7,8,9] The absorption rate of inhaled mercury vapor is extremely high, with approximately 80% of the inhaled dose reaching the brain tissue within one blood circulation cycle. The amalgam also consists of 35% silver, 9% tin, 6% copper and a trace of zinc.[6] More than 100 million mercury fillings are placed each year in the U.S. as over 90% of dentists use them for restoring posterior teeth.[10]

Statements made by the dental profession, which claim that the amount of mercury exposure encountered by patients from dental amalgams is too small to be harmful, are contradicted by the scientific literature and are totally indefensible.[11] Dentists do not receive training that would enable them to monitor for symptoms related to mercury toxicity. The fact that mercury amalgam fillings are banned in many countries in Europe is strong evidence of the clinical toxicity of this material.

Any metal restoration placed in the mouth will produce electrogalvanic effects. These subtle electric fields will adversely affect brain function. Brain cells have electric potentials of approximately one millivolt (millionth of a volt) and they communicate with each other through these minute electric fields. The current that is generated by metal restorations in the mouth (electrogalvanism) is far greater than the current that runs the brain. Ideally, the mouth should be metal restoration free to minimize these potentially disturbing influences, which will interfere with optimal brain function. Even if the metal is biocompatible and properly placed with no occlusion problems, the metal in the mouth will impair some elements of optimized brain function.

Pathophysiology

From a scientific point of view, there is no more "controversy" about the ill health effects of dental amalgams. There is no debate about the fact that mercury in the central nervous system (CNS) causes psychological, neurological, and immunological problems in all humans.[12,13] These symptoms and literature are carefully reviewed elsewhere.[14]

The sheep and monkey studies conducted at the University of Calgary, Canada-under the guidance of Dr. Murray Vimy -showed that radioactively labeled mercury released from freshly and correctly placed amalgam fillings appeared quickly in the kidneys, brain and wall of the intestines.[15.] Mercury bonds very firmly to structures in the nervous system through its affinity for sulfhydryl-groups on amino acids. Other studies showed that mercury is taken up in the periphery by all nerve endings and rapidly transported inside the axon of the nerves (axonal transport) to the spinal cord and brainstem.[16]

Laboratory studies have shown that within 24 hours of injecting a minute dose of mercury into a muscle anywhere in the body it is quickly present in the spinal cord and brain. The mercury was also present in the kidneys, lungs, bloodstream, connective tissue, adrenal and other endocrine glands. In the brain, it tended to congregate in the hypothalamus, which regulates the sympathetic nervous system, and in the limbic system.

Mercury vapor is hydrophobic or lipophilic and does not bind with oxygen and transfers directly into the tissue. Mercury also migrates from the teeth into the tissues through the process of chewing that converts small amounts of amalgam into mercury vapors and particles that are swallowed and absorbed in the GI tract. This is metallic mercury and easily penetrates all cells. Catalase is an enzyme in the cell attaches mercury to a sulfhydryl group inside the cell. Mercury is taken up into the lymphatics, into the veins, and then runs into the gut, and then to the liver, and then into the gallbladder. Mercury then dumps back into the gut and recycles. This is called enterohepatic circulation.

Mercury also is absorbed in the lymphatics of the lower jaw, which go straight into the cervical lymphatic chain and into the thyroid, and then dumps into thoracic veins. Lymphatics of the upper jaw are continuous with the brain and, within seconds, mercury absorbed there goes directly into the brain. The half-life of mercury in the body is suggested to be about three to six weeks, but that is because it is not measured in the tissues. Mercury does not appear to have a "half-life" in the central nervous system as it binds relatively non-reversibly with CNS tissue. Mercury, once in the nervous system, stays there permanently, unless it is detoxified.

Tubulin forms tubular structures within each nerve, along which the nerve-cell transports metabolic waste from the nerve cell into the periphery and along which the nutrients required by the nerve cell are transported from the periphery to the cell. Mercury contributes to further toxicity on its route to the CNS from the periphery by immobilizing the enzyme that is essential for "making" tubulin. Once mercury has traveled up the axon, the nerve cell is impaired in its ability to detoxify and nurture itself. All of the nerve nutrition is through the nerve ending and travels up the tubulin into the cell nucleus through the axon. The mercury-contaminated nerve cell becomes toxic and lives in a state of chronic malnutrition if it is able to survive this toxin. This is due to mercury's inhibition of the polymerization of tubulin, which is essential for the formation of microtubules.[16] Mercury, in all of its forms, is a powerful neuro-toxicant that can destroy the tubulin molecules when it is taken up by the nerve synapse through the mucous membranes in the mouth. Inorganic mercury inhibits the function of tubulin, a critical protein for the brain to perform properly.[14,15]

Mercury Toxicity Symptoms

The overt clinical effects resulting from toxic exposure to mercury have been clearly described.[17,18] The scientific literature shows that amalgam fillings have been associated with a variety of problems such as autoimmunity,[19,20,21] kidney dysfunction,[22] and interference with the immune system as measured by the T-lymphocyte count.[23,24] Patients with many amalgam fillings will also have an increase in the prevalence of antibiotic resistant bacteria.[25] Subclinical neuropsychological and motor control effects were also observed in dentists who had documented high mercury exposure levels.[26,27] Amalgam use may also be related to fatigue, poor memory and certain psychological disorders.[28]

The presence of infertility has increased from 8 to 15% over the past two decades, which may be related to mercury exposure.[29] Heavy metals induce modifications of neurotransmitters in the central nervous system and impair the pulsatile hypothalamic release of gonadotropin-releasing hormone.[30] Dental assistants were found to have half the conception rate compared to women without mercury exposure.[31] Removing the mercury seems to be associated with an improved fertility rate.[32] There is also an increased rate of hormonal disorders among women exposed to mercury. Polycystic ovary syndrome as a result of mercury exposure has also been described.[33]

The earliest symptoms of long term, low level mercury poisoning are subclinical and neurological. Subsequently, due to their subtlety, these symptoms are easily misdiagnosed. Intracellular mercury can cause chronic fatigue, cancer and learning disabilities. Extracellular symptoms of mercury toxicity include: CNS irritability, anxiety, nervousness, fearfulness, emotional instability, loss of self-confidence and shyness. In adolescents, these symptoms are particularly damaging as they impair one's normal social development. Additional symptoms may include: loss of memory, especially room-to-room memory, impaired concentration, and insomnia.

It is well documented that lead and cadmium can cause hypo or hyperthryoidism.[34]. Mercury toxicity will also tend to cause hypothyroidism. The most frequent cause of hypoglycemia is excessive sugar and grain consumption. However, it can also be exacerbated by mercury toxicity. Mercury toxicity can also increase food allergies.[35] Detoxification of mercury will frequently improve these allergies. Additionally, fibromyalgia pain, which is frequently experienced as areas of numb and burning pain, is improved with mercury detoxification.

Mercury and Chronic Infections

As referenced above, mercury clearly has a variety of detrimental impacts on the immune system. Many practitioners have long observed that patients diagnosed with chronic viral illnesses (EBV, CMV, HIV, herpes zoster and genital herpes, CFIDS, etc.), chronic fungal illnesses (Candidiasis and others), and recurrent episodes of bacterial infections (chronic sinusitis, tonsillitis, bronchitis, bladder/prostate infections, HIV related infections) often have dramatic recoveries following an aggressive mercury/amalgam detoxification program.[36]This would support a general immune enhancing benefit of any effective mercury detoxification program. It has also been shown that the presence of amalgam fillings conveys immunity to antibiotics to various bacteria and also impairs the body's own defense system. Mercury is, therefore, the only substance ever shown that induces antibiotic resistance in bacteria, other than an antibiotic itself.[78] It is known that bacteria cause periodontal disease and that the removal of amalgam fillings can often be curative.[77] Unfortunately, there are no studies to date that have tested the mercury hypothesis in other infections, even though the clinical evidence is overwhelming.

Testing -- The Diagnostic Dilemma

It is important to note that prior to beginning any detoxification protocol one should perform a chemistry profile to test for kidney and liver function. Mercury, once it is released into the body, is quickly and firmly bound in the peripheral and central nervous system (brain, spinal chord, peripheral motor and sensory ganglia, autonomic ganglia). Except for a short period after acute exposure, mercury's rapid transport to the nervous tissue dramatically limits its presence in the blood, hair, urine, feces, sweat or any other body fluids . Therefore, a regular trace-element analysis of any body compartment (hair, whole blood, or red cell) will generally not show any evidence of mercury toxicity unless the patient is actively detoxifying mercury. However, there are three traditional tests used for mercury diagnosis.

1. Porphyrins. The most accepted test for metal toxicity in the traditional medical community is the determination of porphyrins in the urine.[37] Certain porphyrins are elevated in blood and urine.
2. Hair analysis. One must use this test with caution though. One could have a result showing low levels of mercury yet have high levels in their tissues. One can do a hair analysis six weeks after starting a mercury detoxification program and it should be high in mercury, which suggests that the mercury is transferring from the tissues into the blood and being excreted into the hair follicles.
3. Challenge tests with complexing or chelating agents (administration of appropriate agents followed by mercury urinalysis). Chelation involves the incorporation of a metal/metalloid ion into a heterocyclic ring structure. A chelating agent forms a ring structure with a metal or metalloid. A metal complexing agent is a more general term, which includes a chelating agent. When used for treating heavy metal poisoning, the administration of the chelating agent results in the formation of a chelate structure. The chelating agent usually has a greater affinity for the metal ion than do endogenous ligands to which the offending metal is bound. The metal chelate usually has water solubility greater than that of the offending metal ion and thus increases it excretion by the kidney.

DMPS and DMSA Chelation Challenge Test

The use of a provocative or challenge test for estimating the body content or exposure to a heavy metal is well established in medicine. The challenge test may need to be performed before beginning amalgam removal for legal documentation. However, many clinicians' experiences have shown that when a patient is mineral deficient (especially sodium, calcium, potassium or sulfur), the body is unable to mobilize toxic metals with a challenge test. The mineral status needs to be corrected prior to successful mobilization for mercury. Chelation challenges are generally done with DMPS and DMSA, which are chelating or complexing agents. The first suggestion for the use of DMPS as a provocative or challenge test for mercury was made in 1981.[38] It was first used in the western world in 1988.[39] The patient is generally given a dose of one or the other immediately after emptying their bladder.

DMPS-stimulated excretion of all heavy metals reaches a maximum after 2-3 hours and decreases thereafter to return to baseline levels after 8 hours.[40] So the urine is collected for and analyzed for mercury content. Most of the mercury will come out relatively quickly so many physicians will have the patient wait in the office or go out to lunch and then come back in 90 minutes after the chelation and collect the urine specimen. It is important to remember that mercury is heavier than water. So when taking an aliquot from the urine sample, it is helpful to shake the sample first prior to pouring it into the container that will be sent to the lab for analysis. If using the DMSA challenge, one should collect the urine for six hours. DMPS is more potent than DMSA, thus a significant urine level of mercury with DMPS would be above 50 mgs while with DMSA, 10 or more mgs would be considered a significant amount.

Basics of Treatment

One of the essential initial steps of therapy is to optimize the diet BEFORE metal detoxification starts. One needs to decrease processed foods, stress and sugar. It would be best to limit fluids to water exclusively and minimize or eliminate all sugar, milk and wheat. These changes will improve immune competency and the body's ability to tolerate the detoxification process. More details are available in the Reaching for Optimal Wellness article. The latest version can be found on the Internet at www.mercola.com. It is listed under a button called "Read This First" on the home page.

Mercury Compartmentalization

Metals are stored in many different body compartments. Each compartment requires different detoxification approaches. The different compartments are intracellular, extracellular (connective tissue), intravascular, kidneys or gut wall and central nervous system. Chlorella is used to shuttle mercury out of the gut. Chlorella and DMPS[41,42] have powerful detoxification abilities on the connective tissue. It is important to begin detoxification by first unloading the connective tissue. This is best achieved with chlorella. When this is accomplished, one can then begin intracellular detoxification. DMSA or cilantro will move mercury out of the cell and brain. Sulfur containing substances like garlic,[43] DMPS or DMSA will mobilize mercury out of the kidneys.

Muscle testing has shown that during mercury detoxification large amounts of mercury are not only excreted via the kidneys but also appear in the small intestine/upper colon (especially when Chlorella and Cilantro are used). They are excreted both via the liver-gall bladder-small intestine pathway, as well as through direct active and passive transport from the intestinal vessels into the lumen. However, the excreted stool contains a much lesser amount of mercury than the lower part of the small intestine/upper part of the large intestine. This suggests re-absorption of mercury during its passage through the colon.

Chlorella

Algae and other aquatic plants possess the capacity to take up toxic trace metals from their environment, resulting in an internal concentration greater than those of the surrounding waters. This property has been exploited as a mean for treating industrial effluent containing metals before they are discharged, and to recover the bioavailable fraction of the metal.[44] Chlorella has been shown to develop resistance to cadmium contaminated waters by synthesizing metal-binding proteins.[45] A book written for the mining industry, *Biosorption of Heavy Metals,* details how miners use organisms called biomasses to increase the yield of precious metals in old mines. These biomasses are sprayed into the mineshaft, washed out with water, and collected on ion exchange membranes. A biomass is a sludge of membranes usually from mono-cellular organisms that have a tendency to accumulate metals that they are exposed to in their outer cell wall.

Dr. Klinghardt believes that most, if not all chronic infectious diseases are not caused by a failure of the immune system but are a conscious adaptation of the immune system to an otherwise lethal heavy metal environment. Mercury suffocates the intracellular respiratory mechanism and can cause cell death. So, it is speculated that the immune system makes a compromise: it cultivates fungi and bacteria that can bind large amounts of toxic metals. This allows the cells to breathe. However, the system is compromised, as it has to provide nutrition for the microorganisms and has to contend with their metabolic by-products ("toxins"). These organisms, especially Candida, can frequently grow uncontrollably. When this occurs, the patient experiences the so-called "die-off effect" (the sometimes severe crisis or even lethal reaction a patient can have in the initial stages of aggressive pharmaceutical antifungal or antibacterial treatment). This is often due to acute heavy metal toxicity-metals released from the cell walls of dying microorganisms.

The list of organisms that have the highest affinity for toxic metals covers the full spectrum of typical infectious diseases: fungi of the candida species, streptococci, staphylococci, and amoebas, among many others. However, two algae top the list of organisms in their ability to effectively bind to mercury: Chlorella pyreneidosa and Chlorella vulgaris. Although spirulina and super blue green algae are also algae with other health benefits, the mining and clinical research does not support their use in binding these heavy metals.

Chlorella appears to have two significant mechanisms of action that make it an ideal agent to be used in a toxic-metal treatment protocol. Its cell wall absorbs rather large amounts of toxic metals (similar to an ion exchange resin). Either the specific combination of amino-acids, the chlorella derived growth factor, or some other yet unknown mechanism leads to mobilization of some mercury from within the cell. It enhances mobilization of mercury compartmentalized in non-neurologic structures such as the muscles, ligaments, connective tissue, and bone.

Chlorella is an essential part of the detoxification program, as approximately 90% of the mercury in our bodies is eliminated through the stool. To increase the fecal excretion of mercury, certain principles should be applied. First, it is wise to first start the mercury detoxification by first unloading the connective tissue with chlorella. Large doses of chlorella will clear out the mercury that can frequently contaminate the colon. Chlorella works likes a sponge to suck up mercury from the body. Chlorella only pulls mercury out of the gut wall. Once the gut is cleared, the mercury will then, by osmosis, go into the gut from other body tissues where chlorella will effectively remove it from the body.

Chlorella Dose

The powder is the most cost effective approach but some people will prefer the tablets or capsules for convenience. One can start out with a one quarter of a teaspoon of the powder (one 500 mg tablet) once a day initially to confirm that there is no hypersensitivity present. Work up to 3/4 of a teaspoon (5- 500 mg. tablets) with every meal. Every tenth day you can take a large dose of one tablespoon (16- 500 mg tablets) with each meal. A simple way to dissolve the powder is to place it in a container with a lid partially filled with water. Then tighten the lid and shake to dissolve and drink the solution. Most people find it inconvenient to spread the doses out to include the lunch meal. Therefore, one could possibly increase the normal daily dose to 1 1/2 teaspoons with breakfast and dinner for convenience. CAUTION: If at any time one develops nausea or starts "burping up" the chlorella taste then the chlorella should be stopped immediately as a food sensitivity is developing which will only worsen if you continue taking it.

Chlorella is also very helpful for removing radioactive metals or fallout. Amalgam tattoos are black deposits on the gum and cheeks that are due to mercury deposits. These are typically removed surgically. Chlorella can be used to remove the amalgam tattoos noninvasively by sticking the chlorella powder on a cotton roll and placing it on the tattoo overnight. The treatment requires about two weeks to remove the tattoo.

Cilantro

Dr. Omura has found that Cilantro (Chinese parsley) can mobilize mercury and other toxic metals rapidly from the CNS and the brain when appropriate amounts are consumed daily.[46] [47] Cilantro mobilizes mercury or tin stored in the brain and in the spinal cord and moves it into the connective tissues, Cilantro is especially useful for removing mercury from the brain, as brain detoxification is one of the most difficult to achieve. The mobilized mercury appears to be either excreted via the stool, the

urine, or translocated into more peripheral tissues. This is a revolutionary discovery and makes cilantro the first known substance that mobilizes mercury from the CNS.

The active principle is unknown. Dried cilantro, however, does not work which suggests that the active substance is in the volatile fat-soluble portion of the plant. It would be wise to use fresh cilantro as a seasoning four to five times a week. A pesto can also be prepared by purchasing fresh organic cilantro and putting it in a blender with a small amount of water, sea salt and olive oil. Blend this until creamy. Take 1 tablespoon 3 times/day with meals. A tincture is also available and the dose is ten drops three times a day, however, the commercial distillates are not as cost effective as using the fresh herb. Coriander may also be similarly useful although it is not as well studied. Cilantro does not facilitate the removal of heavy metals out of the body; this usually requires DMPS or DMSA with Chlorella and sauna treatment. The use of Cilantro with DMSA or DMPS has actually been documented to show an increase in motor nerves following DMSA or DMPS administration.[48]

Porphrazyme

This is a special form of chlorophyll from Biotics Labs that seems to be especially useful for mercury detoxification. It consists of a group of different porphyrins that facilitates metal excretion. In nature, porphyrins are used to shuttle metals to different systems. The porphryn ring structure of chlorophyll, which contains magnesium, is similar to the porphryn ring structure in hemoglobin, which contains iron. Porphrazyme can assist mercury removal and is generally taken one to three tablets three times a day for one to two years.

Minerals

It is important to have a generally healthy mineral base. It appears that the body works better with toxic metals than no metals at all. Enzymes have certain binding sites that require a metal for them to perform their function as a catalyst. When patients are deficient in magnesium, sodium, zinc and other minerals, the body does not let go of the toxic metals very easily. A person with mercury contamination often becomes zinc deficient and the functioning of copper and other minerals in the body will be compromised as well. So, it will be important to have a healthy mineral base. Selenium,[49,50, 51] is a particularly important trace mineral in mercury detoxification and should be used for most people.

If a person does not have a sufficient amount of hydrochloric acid secreted by their stomach then it will be very difficult to ionized mineral supplements to absorb them properly. There is a sternal reflex present on the lowest rib approximately one inch lateral to the midline. If this area on the rib is tender to palpation there is a strong likelihood the person is deficient in hydrochloric acid and would benefit from supplementation. This is especially common in individuals over 50 years old, and also in individuals with food allergies. One to six capsules of Betaine hydrochloride is generally taken with the first bite of every meal for proper digestive support. The Betaine can be discontinued once the reflex point in non-tender to deep palpation.

Optimize Bowel Flora.

It will be important to consider use of a probiotic that has more strains than just Lactobacillus acidophilus. Consider using one that has many different strains and in high concentration or one of the preparations that have soil based organisms such as Bacillus subtilis. There is some concern that FOS used in many products may be counterproductive by encouraging the growth of certain pathogenic anaerobes such as Klebseilla. There is some suggestion that soil-based organism products may be particularly useful in recolonizing the gut.

Optimize Bowel Transit Time

One should make certain that the patient is having two to three bowel movements per day. This will decrease the likelihood for mercury reabsorption during the detoxification process. If the patient is having less than that number, it will be important to have thyroid function checked. The most sensitive assessment would be a TSH, Free T3 and Free T4. A TSH level above 1.5 suggests hypothyroidism, while Free T3 and Free T4 levels in light of a normal TSH below 1.5 could suggest pituitary or hypothalamic hypothyroidism. If the thyroid function is normal, one should use large doses of magnesium glycinate or citrate or vitamin C to increase the stool frequency. However, it is important not to have loose stools, as this would be counterproductive.

MSM (Methyl Sulfono Methane)

MSM is a form of organic sulfur; it is similar in many ways to DMSO. All the mercury detoxification agents, with the exception of chlorella and cilantro, work by facilitating mercury's binding to sulfhydryl groups. Most patient's sulfur systems are greatly depleted as a result of detoxifying environmental toxins and excreting sulfur in the gallbladder and intestine. Typical available sulfur stores are not sufficient to cope with the environmental stresses to which we are exposed. Because of this depletion, we cannot utilize the chelating sulfur agents until we restore our sulfur stores Unless this sulfur is replaced when one uses sulfur based chelating agents like DMPS or DMSA, the body will use the sulfur from the chelating agent. The chelating agents will thus be impaired and converted to a non-functional status, thus unable to bind to mercury. They will, however, function as an extraordinarily expensive sulfur supplement. If we use DMPS or DMSA without preloading sulfur stores, the body will use the sulfur in the DMPS or DMSA and break it down before it uses it to bind to mercury. So, it is necessary to build up sulfur with products like MSM. The initial dose is a half-teaspoon or half capsule once a day. One then slowly works up to one capsule or one teaspoon twice a day. If one uses MSM, garlic is unnecessary, as the main purpose of both MSM and garlic is to supply organic sulfur.

Essential Fatty Acids

Most people are deficient in these vital nutrients. Many employ flaxseed oil as a strategy to address this deficiency. However, this strategy can backfire for most people. This is easily determined by noticing any nausea after consuming flax oil. Nausea is a powerful indication that the supplement should not be used. It is likely that inhibition of the delta 6-desaturase enzyme by excessive grain ingestion with its secondary hyperinsulinemic actions will impair proper metabolism of the flax oil. High levels of alpha linoleic acid build up which impair fatty acid biochemistry. Generally, one to two tablespoons of whole flaxseed that is ground in a coffee grinder immediately prior to using seems to circumvent this problem. It is generally safe for most people to use Evening Primrose Oil as the preferred essential fatty acid, as it is high in gamma linolenic acid (GLA) and does not have other fatty acids present that can disrupt fatty acid biochemistry. Although borage oil is less expensive, most people have problems with the nervonic acid levels in borage oil. The GLA in the Primrose Oil should be balanced with the EPA/DHA from fish oil capsules in a 4:1 ratio. The dose of the GLA should be about 250 to 1000 mg per day.

Vitamins

Vitamin E is also helpful. Many physicians believe the Unique brand vitamin E is one of the better options available as it uses a high-grade material of mixed natural tocopherols. One of the 400 unit capsules should be more than sufficient. Vitamin C is also a helpful supplement for detoxification[52] and doses are about 500 mg, three times a day.

DMPS

DMPS (Sodium 2,3-dimercaptopropane-1-sulfonate) is an acid with a free sulfhydryl group that forms complexes with heavy metals such as mercury, cadmium, arsenic, lead, copper, silver, and tin. It is a water-soluble complexing agent. It was developed in the former Soviet Union by Petrunkin[53] and has been used to treat metal intoxication since the 1960s in the former Soviet Union. Because it had potential use as an antidote for the chemical warfare agent Lewisite it was not available outside of the Soviet Union until 1978, at which time Heyl, a small pharmaceutical company in Berlin, Germany started to produce it. It has an abundance of international research data and an excellent safety record in removing mercury from the body[54] and has been used safely in Europe as Dimaval for many years.[55 56 57 58 59I] It is registered in Germany with the BGA (their FDA) for the treatment of mercury poisoning and in fact is available in Germany without the need of a prescription.

American toxicologists working with Iraqi physicians first used it for treating people who had eaten bread prepared from grain seeds that had been treated with a mercury-containing fungicide.[60] The use of DMPS to treat mercury toxicity is well established and accepted.[61] DMPS and DMSA have been shown to reverse systemic autoimmune disease in rats.[65]

Both DMPS and DMSA have sulfur which binds very tightly to mercury. DMPS has at least three advantages over DMSA. First, it appears to remain in the body for a longer time than DMSA.[62] Secondly, it acts more quickly than DMSA, probably because its distribution is both intracellular and extracellular.[63] Thirdly, preparations of DMPS are available for intravenous or intramuscular use, while DMSA is available only in oral form.[64]

DMPS does not cross the blood brain barrier, or the barrier into certain body areas that are "compartmentalized" and are areas of low perfusion. Therefore, it will also be important to pretreat with cilantro so the mercury in the brain can be removed. MSM and chlorella should also be used for at least three weeks prior to initiating DMPS treatment. Combining high does of Chlorella with, before, during, and after the challenge test can dramatically increase the amount of mercury mobilized by the challenge and excreted out of the body.

DMPS is a prescription chemical that can be ordered by a physician through a number of compounding pharmacies. The dose is 3 mg/kg of body weight which is injected slowly intravenously over five minutes. This is followed by a 90 minute or 24 hour urine test for mercury. The dose is 3 mg per kg once a month and it is generally given in an equal amount of procaine 1% without preservatives. DMPS is expensive and may not be required to detoxify mercury. High doses of chlorella and cilantro are far more cost effective and have been found to be very effective in Germany for mercury detoxification.

Intravenous DMPS should not be used in patients that still have silver amalgam fillings. The DMPS may chelate out significant amounts of mercury and precipitate seizures, cardiac arrhythmias, or severe fatigue. DMPS is not mutagenic, teratogenic or carcinogenic. Even though DMPS has a high affinity for mercury, the highest affinity appears to be for copper and zinc.[66] If one uses DMPS, it will be important to supplement with the minerals to prevent a zinc or copper deficiency. One precaution is that DMPS should be given over a five-minute period since hypotensive effects are possible when given intravenously as a bolus.[67 68] Other possible side effects include allergic reactions and skin rashes.

Sulfur Bearing Amino Acids

Sulfhydryl containing compounds have the ability to chelate metals. The sulfur containing amino acids methionine, and cysteine, cysteine's acetylated analogue N-acetylcysteine (NAC), S-adenosyl-

methinoinine, alpha-lipoic acid, other salts of succinic acid such as magnesium succinate, and the tri-peptide glutathione all contribute to the chelation and excretion of metals from the human body.[69] One of the sulfur bearing amino acids appears to be particularly useful in mercury detoxification. Redoxal consists of dl-methionine and the typical dosage is one to two capsules before each meal.

DMSA and NAC

DMSA (meso-2, 3-dimercaptosucccinic acid) is a form of succinic acid but is a synthetic chemical not normally used in its routine functioning biochemistry. It is a much more effective mercury chelating agent then d-penicillamine.[70 71] It is the only chelating agent other than cilantro and d-penicillamine that penetrates brain cells.

The dose is of DMSA is 500 mg twice a day for two weeks. The DMSA is then stopped for two weeks and then the cycle is repeated. In children, the dose is one half the adult dose (250 mg for six year old, while a two year old receives 125 mg DMSA). Patients six years or younger seem to do much better with DMSA relative to DMPS. The average adult needs about two years on this protocol. DMSA costs $6.00 for one 500 mg tablet if written as a prescription, but is much less if it is filled at a compounding pharmacy. MSM will help move the DMSA out of the kidney. One should do a urine mercury level by collecting at 90 minutes. It is important to recognize that the sulfhydryl compounds in DMSA will make the urine smell very sulfurous. It is helpful to communicate this to the patient so they are not taken by surprise.

Potentiating Agents

Hyaluronic acid is a major carbohydrate component of the extracellular matrix and can be found in the skin, joints, eyes and most other organs and tissues. It has a simple, repeated disaccharide linear copolymer structure that is completely conserved throughout a large span of the evolutionary tree, indicating a fundamental biological importance. Through its complex interactions with matrix components and cells, hyaluronic acid has multifaceted roles in biology utilizing both its physicochemical and biological properties. These biological roles range from a purely structural function in the extracellular matrix to developmental regulation through effects of cellular behavior via control of the tissue macro- and microenvironments, as well as through direct receptor mediated effects on gene expression.[73] Hyaluronic acid is utilized in many chemotherapy protocols as a potentiating agent.[74] Hyaluronic acid is also being utilized for many novel applications in medicine.[75 76] Personal experience has shown that the addition of 2 ml with the DMPS tends to improve the excretion of mercury by two-fold. There is virtually no toxicity with this agent.

Homeopathic Therapies

The primary target organ in which inorganic mercury accumulates and expresses toxic effects is the kidney. There is a danger that the mercury may lodge in the kidney, which may damage it if appropriate measures are not taken.[72] Homeopathic drainage remedies are helpful to allow the mercury to pass through the kidney and minimize potential toxicity. One of the commonly used remedies would be Solidago. Once extracellular detoxification is completed there are a number of effective homeopathic heavy metal or mercury remedies that are also useful.

Amalgam Removal Protocol

Two Months Prior to Removal Do the Following Four Items:

1. **Vitamins and minerals**. Start on vitamin E 400 units per day and use a high quality mineral supplement. Selenium 2-400 mcg should be part of the mineral replacements. Deficiencies of hydrochloric acid will impair mineral absorption. One should check for adequacy of hydrochloric acid secretion and take the appropriate acid supplement if indicated. The sternal reflex point described above is a useful tool in this determination.

2. **Start on chlorella**. Establish the highest tolerated level. If excessive mercury is mobilized, the patient will become symptomatic with nausea, heartburn, diarrhea, a flu-like illness, and headache. The lower the tolerated amount, the more intracellular mercury toxicity is present. The tolerated level ranges often from 1/10 teaspoon to one tablespoon (1/2-14 capsules). Give no more than one tablespoon (14 caps) /day initially. Stay on the daily dose days 1-8. On day 9 and 10, take ten-fold that amount, but no more than 3 tablespoons (60 caps) /day. On day 11 and 12, pause. And then, start over. Take with meals in divided doses.

3. **MSM** should be used as described above.

4. **Cilantro**, fresh or pesto, is also used as described above.

The Day of Removal and Afterwards

1. If the patient were compromised it would be best to remove only one filling and observe how they tolerate the procedure. If they tolerate the removal they can then proceed to one or two quadrant removal based on the number of fillings present.

2. The day of the dental work (amalgam removal), take 20 caps Chlorella immediately before dentistry. After the fillings are removed, open 2 capsules, sprinkle onto teeth, mix with saliva, and keep in mouth for 10 minutes to mop up metal residues. Don't swallow. Instead, spit out and rinse mouth. Repeat both steps after procedure is over. Repeat again that night. Then resume regular program. Also, take extra MSM and chlorella.

3. The mercury /tin/silver antibody titer may rise over 2-6 weeks after the first removal. Don't remove more fillings during this time in order to avoid acute “immune breakdowns.” Either finish all 4 quadrants in the first weeks or have a session every 2-3 months.

4. Don't stop detox program until patient is asymptomatic. This can be as long as 3-4 years in some cases.

BIBLIOGRAPHY

1. Harrison IA; Some electromchemical features of the in vivo corrosion of dental amalgams. J Appl Electrochem 19: 301-310, 1989.

2. Skare I, Engqvist A; Human exposure to mercury and silver released from dental amalgam restorations. Arch Environ Hlth 49:384-394, 1994.

3. World Health Organization. Environmental Health Criteria. 118, Inorganic Mercury (Friber I, ed) WHO Geneva 1991.

4. Lorschider, F, Vimy MJ, Summers, AO: Mercury xposure from "silver" tooth filligs: Emerging evidence questions a tradtional dental paradigm. FASEB J 9:504-508, 1995.

5. Morbidity and Mortality Weekly Report (MMWR), July 9, 1999

6. Lorscheider F, Vimy MJ: Evaluation of the safety issue of mercury release from dental fillings. FASEB J 7:1432-1433, 1993.

7. Svare CW, Peterson LC, Reinhardt JW, Boyer DB, et.al; The effects of dental amalgams on mercury levels in expired air. J Dent Res 60:1668-1671, 1981.

8. Vimy MJ, Lorscheider F; Intra-oral air mercury released from dental amalgam. J Dent Res 64:10069-1071, 1985.

9. Aronsson AM; Lind B, Nylander M, Nordberg M; Dental amalgam and mercury. Biol Metals 2:25-30, 1989.

10. Berry TC, Nicholson J, Torendle K; Almost two centuries with amalgam. Where are we today? J Am Dent Assn 120:394-395, 1994.

11. Hanson M, Pleva J: The dental amalgam issue. A review. J Experentia. 47:479-22. 1991.

12. Nierenberg DW, Nordgren RE, Chang MB, et al. Delayed cerebellar disease and death after accidental exposure to dimethylmercury. N Engl J Med. 1998 Jun 4; 338(23): 1672-1676.

13. Clarkson TW; Mercury - an element of mystery. NEJM 323:1137-1139, 1990.

14. The toxicological profile of mercury. 1994 publication by the US Department of Health and Human Services (Agency for Toxic Substances and Disease Registry, Division of Toxicology; 1600 Clifton Road NE E-29, Atlanta, GA 30333).

15. Hahn LJ, Kloiber R, Leininzer RW, Vimy MJ, Lorscheider FI; Whole-body imagine of he distribution of mercury released from dental fillings into monkey tissues. FASEB J 4:3256-3260. 1990.

16. Eggleston DW, Nylander M; Correlation of dental amalgam with mercury in the brain. J Prost Dent. 58:704-707. 1987.

17. Lorscheider FI, Vimy MJ, Pendergrass JC, Haley BE: Toxicity of ionic mercury and dental mercury vapor on brain neuronal protein metabolish. Neurotoxicology 15:955, 1994.

18. Falconer MM, Vaillant A, Reuhl KR, Laerrie N, Brown DL; The molecular basis of microtubule stability in neurons. Neurotoxicology 15:109-122, 1994.

19. Clarkson TW, Hursh IB, Sager PR, Sverson TLM: Mercury. In Biological Monitoring of Toxic Metals (Clarkson TW, Friberg L, Nordberg CF,, and Sager PR, eds) pp 199-246. Plenum, New York 1988.

20. Klassen CD. Heavy metals and heavy-metal antagonitsts. In The Pharmacological Basis of Theraputics, 8th edition(Gilman AC, Rall TW, Niew AS, Taylor P, eds) pp. 1598-1602. Pergamon Press, New York 1990.

21. Hirsch F, Kuhn J, Ventura M, Vial MC, Fournie G, Druet P; Production of monoclonal antibodies. J Immunol 136:3272-3276, 1986.

22. Hultman P, Johansson U, Turley Sj, Lindh U, Enestrom S, Pollard KM; Adverse immunological effects and autoimmunity induced by dental amalgam and alloy in mice. FASEB J 8:1183-1190, 1994.

23. Biagazzi M, Pierlguigi E; Autoimmunity and heavy metals. Lupus 3:449-453. 1994.

24. Nylander M, Frierg I, Lind B; Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. Swed Dent J 11:179-187, 1987.

25. Lawrence Toxocol Appl Pharmacol 1981 57:439-451

26. Pelletier J Immunol 1988 140:750-754.

27. Summers AO, Wireman J, Vimy MI, Lorscheider FI, Marshall B, Levy SB, et al; Mercury released from dental Asilver@ fillings provokes an increase in mercury and antibiotic-resistant bacteria in oral and intestinal floras of primates. Antimicrob Agents and Chemother 37:825-834, 1993.

28. Scheverria D, Hever N, Martin MD, Naleway CA, Woods JS Bittner AC; Behavioral effects of low level exposure to mercury among dentists. Neurotxicol Teratol 17:161-168, 1995.

29. Ngim CH: Chronic neurobiological effects of elemental mercury in dentists. Br J Indust Med 49:782-790, 1992.

30. Siblerud RL; The relationship between mercury from dental amalgam and mental health. Am J Psychotherapy 18:575-587, 1989.

31. Dondero F, Lenzi A, Lombardo F, Gandini L; 1991. Therapy of immunologic infertiilty. Acta Eur Fertil 22:139-145

32. Duhr E, Pendergrasss C, Kasarskis E, Slevin J Haley B; 1991 Mercury induces GTP-tubulin interactions in rat brain similar to those observed in Alzheimer=s disease. FASEB J 5:456.

33. Rowlands AS, Baird DD, Weinberg CP, Shore DL, Shy CM, Wilcos AJ. 1994 The effect of occupational exposure to mercury vapor on the fertility of female dental assistants. Occup environ Med 51:28-34.

34. Gerhard I, Monga B, Waldbrenner A, Runnebaum B Heavy metals and fertility. J Toxicol Environ Health 1998 Aug 21;54(8):593-611

35. Gerhard I, Frick A, Monga B: 1997 Diagnosis of mercury body burden. Clin Lab 43:637-647

36. Klages K, Sourgens H, Gbertram HP, Mueller C, Kemper FH: 1987. Led expousre and endocrine functions: Impact on the hypphyseal-gonadal axis and the pituitary-thyroid system. Acta Endocrinol Suppl 283: 17-18

37. Hultman P, Johansson U, Turle S,J, Lindh U, Enestroom S, Pllear KM: 1994 Adverse immunological effects and autoimmunity induced by dental amalgam and alloy in mice. FASEB J 8:1183-1190.

38. Klinghardt D; Amalgam/mercury detox as a treatment for chronic viral, bacterial and fungal illnesses. Explore 8:13-16, 1997.

39. Roberts MC. Antibiotic resistance in oral/respiratory bacteria. Crit Rev Oral Biol Med 1998;9(4):522-40

40.

41. Klokkevold PR Periodontal medicine: assessment of risk factors for disease. J Calif Dent Assoc 1999 Feb;27(2):135-42

42.

43. Woods JS Altered porphyrin metabolism as a biomarker of mercury exposure and toxicity.Can J Physiol Pharmacol 1996 Feb;74(2):210-215

44. Osinska, J Trojanowska, B: The clinical state of persons with the mercury deposits detected by the use of the unithiol test. Przeglad Lekarski 38:595-598, 1981.

45. Cheerian, MG, Miles EF, Clarkson TW, Cox C: Estimatino of mercury burdens in rats by chelation with dimercaptopropane sulllfonate. J Pharmacol Exp Ther 245:479-484, 1988.

46. Gerhard I; Runnebaum B: 1992 Schadstoffe und Fertiliatatsstorungen

Schwermetalle und Mineralstoffe. Geburtshilfe Frauenheillkd 52:383-396, 509-515

47. Belles M, Sanchez DJ, Gomez M, Domingo JL, Jones MM, Singh PK Assessment of the protective activity of monisoamyl meso-2,3-dimercaptosuccinate against methylmercury-induced maternal and embryo/fetal toxicity in mice. Toxicology 1996 Jan 8;106(1-3):93-97

48. Kostial K, Restek-Samarzija N, Blanusa M, Piasek M, Prester L, Jones MM, Singh PK Racemic-2,3-dimercaptosuccinic acid for inorganic mercury mobilization in rats. J Appl Toxicol 1997 Jan;17(1):71-74

49. Cha CW A study on the effect of garlic to the heavy metal poisoning of rat. J Korean Med Sci 1987 Dec;2(4):213-224

50. Ahner, AB, Kong KS, Morell MM, 1995 Phytochelatin production in marine algea: An interspecies comparison. Limnol Oceanograph 40: 649-657

51. Carr HP, et al. Characterization of the cadmium-binding capacity of Chlorella vulgaris. Bull Environ Contam Toxicol. 1998 Mar; 60(3): 433-440.

52. Omura Y, Beckman SL Role of mercury (Hg) in resistant infections & effective treatment of Chlamydia trachomatis and Herpes family viral infections (and potential treatment for cancer) by removing localized Hg deposits with Chinese parsley and delivering effective antibiotics using various drug uptake enhancement methods. Acupunct Electrother Res. 1995 Aug; 20(3-4): 195-229.

53. Omura Y, Shimotsuura Y, Fukuoka A, Fukuoka H, Nomoto T .Significant mercury deposits in internal organs following the removal of dental amalgam, & development of pre-cancer on the gingiva and the sides of the tongue and their represented organs as a result of inadvertent exposure to strong curing light (used to solidify synthetic dental filling material) & effective treatment: a clinical case report, along with organ representation areas for each tooth. Acupunct Electrother Res. 1996 Apr; 21(2): 133-160.

54. Ewan KB, Pamphlett R Increased inorganic mercury in spinal motor neurons following chelating agents. Neurotoxicology 1996;17(2):343-349

55. Yoneda S, Suzuki KT Toxicol Appl Pharmacol Detoxification of mercury by selenium by binding of equimolar Hg-Se complex to a specific plasma protein. 1997 Apr;143(2):274-280

56. Akesson I, Ingrid B; Status of mercury and selenium in dental personnel: Impact of amalgam work and own fillings. Arch Environ Health 46(2):103-109, 1991.

57. Johansson E: Selenium and its protection against the effects of mercury and silver. J Trace Elements 5:273-274, 1991.

58. Dirks M, Marvin J; Mercury excretion and intravenous ascorbic acid. Arch Environ Health 49(1):49-52 1994.

59. Petrunkin VE: Synthesis and properties of demercapto derivatives of alkylsulfonic acids. Toksikol mosc 21: 53-59 (1958).

60. Torres-Alanis O, Garza-Ocanas L, Pineyro-Lopez A Evaluation of urinary mercury excretion after administration of 2,3-dimercapto-1-propane sulfonic acid to occupationally exposed men. J Toxicol Clin Toxicol 1995;33(6):717-720

61. Aaseth J, Jacobsen D, Andersen O, Wickstrom E Analyst Treatment of mercury and lead poisonings with dimercaptosuccinic acid and sodium dimercaptopropanesulfonate. A review. 1995 Mar;120(3):853-854

62. Aposhian HV, Maiorino RM, Rivera M,, et al Human studies with the chelating agents, DMPS and DMSA. J Toxicol Clin Toxicol 1992;30(4):505-528

63. Aposhian HV, Aposhia MM. Meso-2,3 dimercaptosuccinic acid: chemical, pharmacological and toxicological properties of an orally effective metal chealting agent. Annu Rev Toxicol 30:279-306 (1990)

64. Lorscheider FL, Vimy MJ. Evaluation of he saftey issue of mercury release from dental fillings. FASEB J 7:432-1433. (1993).

65. Aposhian MM, Maiorino RM, Xu Z, Aposhian HV Sodium 2,3-dimercapto-1-propanesulfonate (DMPS) treatment does not redistribute lead or mercury to the brain of rat. Toxicology 1996 May 3;109(1):49-55

66. Schiele R, Schaller KH, Welte D: Mobilization of mercury reserves in the organism by means of DMPS. Occup Med Soc Med Prevent Med 24: 249-251, 1989.

67. Hu H, Moller G, Abedi-Valugerdi M Thiol compounds inhibit mercury-induced immunological and immunopathological alterations in susceptible mice.

68. Clin Exp Immunol 1997 Jan;107(1):68-75

69. Hurlbut KM, Maiorino RM, Mayersohn M, Dart RC, Bruce DC, Aposhian HV Determination and metabolism of dithiol chelating agents. XVI: Pharmacokinetics of 2,3-dimercapto-1-propanesulfonate after intravenous administration to human volunteers. J Pharmacol Exp Ther 1994 Feb;268(2):662-668

70. Zheng W, Maiorino RM, Brendel K, Aposhia HV. Determination and metabolism of dithiol chelating agents. Fundam Appl Toxicol 14:598-607 (1990)

71. Aposhian HV Environ Health Perspect Mobilization of mercury and arsenic in humans by sodium 2,3-dimercapto-1-propane sulfonate. 1998 Aug;106 Suppl 4:1017-1025

72. Sallsten G, Barregard L, Schutz A Clearance half life of mercury in urine after the

cessation of long term occupational exposure: influence of a chelating agent (DMPS) on excretion of mercury in urine. Occup Environ Med 1994 May;51(5):337-342

73. Aposhian HV, Maiorino RM, Gonzalez-Ramirez D, et al. Mobilization of heavy metals by newer, therapeutically useful chelating agents. Toxicology 1995 Mar 31;97(1-3):23-38

74. Gonzalez-Ramirez D, Maiorino RM, Zuniga-Charles M, et al Sodium 2,3-dimercaptopropane-1-sulfonate challenge test for mercury in humans: II. Urinary mercury, porphyrins and neurobehavioral changes of dental workers in Monterrey, Mexico. J Pharmacol Exp Ther 1995 Jan;272(1):264-274

75. Lash LH, Putt DA, Zalups RK Role of extracellular thiols in accumulation and distribution of inorganic mercury in rat renal proximal and distal tubular cells. J Pharmacol Exp Ther 1998 Jun;285(3):1039-1050

76. Kostial K, Restek-Samarzija N, Blanusa M, Piasek M, Jones MM, Singh PK Combined oral treatment with racemic and meso-2,3-dimercaptosuccinic acid for removal of mercury in rats. Pharmacol Toxicol 1997 Nov;81(5):242-244

77. Miller AL. Dimercaptosuccinic acid (DMSA), a non-toxic, water-soluble treatment for heavy metal toxicity. Altern Med Rev. 1998 Jun; 3(3): 199-207. Review.

78. Chen WY, Abatangelo G.Functions of hyaluronan in wound repair. Wound Repair Regen 1999 Mar-Apr;7(2):79-89

79.

80. Delpech B, Girard N, Bertrand P, Courel MN, Chauzy C, Delpech Hyaluronan: fundamental principles and applications in cancer.A J Intern Med 1997 Jul;242(1):41-8

81.

82. Sutherland IW. Novel and established applications of microbial polysaccharides. Trends Biotechnol 1998 Jan;16(1):41-6

83.

84. Knudson CB, Nofal GA, Pamintuan L, Aguiar DJ, The chondrocyte pericellular matrix: a model for hyaluronan-mediated cell-matrix interactions. Biochem Soc Trans 1999 Feb;27(2):142-7

85. Zalups RK, Parks LD, Cannon VT, Barfuss DW Heavy metals and fertility. Mechanisms of action of 2,3-dimercaptopropane-1-sulfonate and the transport, disposition, and toxicity of inorganic mercury in isolated perfused segments of rabbit proximal tubules. Mol Pharmacol 1998 Aug;54(2):353-363