

Part 2: Heavy Metals

A. Methods of Testing for Heavy Metals

Heavy Metals

Heavy metals are chemical elements with a specific gravity that is at least five times the specific gravity of water. Specific gravity is a measure of density. ¹ They tend to be toxic or poisonous at low concentrations. Examples of heavy metals include mercury, cadmium, arsenic, chromium, thallium, and lead. As trace elements, some heavy metals like copper, selenium and zinc are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Heavy metals may enter our body via food, drinking water, air or absorption through the skin and mucous membranes. Heavy metal poisoning could result from drinking contaminated water, high ambient air concentrations near emission sources, or intake via the food chain. The basic way that these heavy metals cause problems is by displacing essential minerals required for important body functions. ²

Signs and Symptoms of Heavy Metal Toxicity

Symptoms will vary depending on the nature and quantity of the heavy metal, and its route of entry into the body. Some symptoms include:

- cramps
- nausea
- vomiting
- diarrhoea
- stomach pain
- headache
- poor concentration ^{2,3}
- sweating
- metallic taste in the mouth
- insomnia
- mania
- convulsions
- fatigue
- muscle pains
- indigestion
- constipation
- anaemia
- pallor
- dizziness

Diagnosis

Heavy metal poisoning may be detected using blood, urine and stool tests, hair and tissue analysis, or x-rays. Those which are readily available in Australia include

- Hair Analysis
- Urine Analysis
- Live Blood Analysis

Hair Analysis

Hair Tissue Mineral Analysis (HTMA), is a special analytical test which measures the mineral composition in a sample of hair. Interpreted correctly, HTMA data may provide indications of mineral imbalances, deficiencies and excesses of many essential and toxic elements. ⁴ When used with other tests, HTMA can greatly assist the natural therapist in assessing a patient's health and nutritional status, and unlike blood or urine tests, it reflects systemic levels of mineral content and long-term retention of heavy metals. ^{4,5}

Hair is formed in the dermis from a cluster of matrix cells that make up the follicle. During the growth phase, metabolic activity is greatly increased, exposing these matrix cells to the internal metabolic environment, which includes the extracellular fluids, circulating blood and lymph. As the hair shaft develops, minerals and other trace elements are keratinised into the growing hair shaft providing a blueprint of the biochemistry occurring, mineral balances and toxic metal exposure. As such, it serves as a permanent record of past events related to health, diet, environment and well being.⁴

Method of Sampling

The sample is usually obtained by cutting a small amount of hair, (approximately 4 cm in length from the scalp), from the nape of the neck location. The hair sample is then prepared in a licensed clinical laboratory through a series of chemical and high temperature digestive procedures. Testing is then performed using highly sophisticated detection equipment and methods to achieve clinically reliable results.⁴

Accuracy and Considerations

Elemental concentrations in hair are often ten times or more greater than that in blood or urine. As such, research has shown that hair more closely reflects body mineral stores than does blood or urine, especially in cases to toxic metal accumulation. Often, hair will show toxicity when blood or urine will not. Also, hair is biologically stable, in that it stores easily, ships well, and will not deteriorate. It is also not buffered against changes as are blood and urine, and it is reflective of systemic mineral levels and metabolic balance over a period of time. In addition, it is reflective of the body's general condition, and not just a specific organ or tissue. Other benefits include the ease of sample collection, in that hair can be cut easily and painlessly; and do not require complicated handling requirements. The procedure is non-traumatic and non-invasive, it is also safe and relatively inexpensive.^{4,5}

Nonetheless there are certain limitations with regards to HTMA. For one, hair that has been permed, dyed, bleached or chemically treated in any way will not provide accurate results. The hair has to be grown for at least another three to four months before new sampling. In addition to colouring, tinting, bleaching and perming agents, shampoos (especially dandruff shampoos) and hair sprays, gel, creams and oils may also contaminate the sample, and give inaccurate readings. This extends to external contaminants that some individuals may come into contact with environmentally and/or occupationally, for example, those who work as welders and miners, or those who swim a lot in swimming pools.^{4,5}

In addition, since the hair samples can be collected by individuals at home and posted to the laboratory, there are further chances for contamination in the process. The hair sample may also be inaccurately obtained, for example, the individual sends in hair that is not from the head. Hair from the pubic, facial and axillary areas will not yield the same information. Even with hair from the head, hairs that are growing side by side may have different trace element contents because they are in different stages of the growth cycle. Approximately a third of head hairs are in a "resting" phase at any one time.^{4,5}

Finally, as hair samples from the nape of the neck are preferred, this method of diagnosis may pose a problem to those who are bald or who suffer from certain forms of alopecia.

Cost: AUS \$120 – \$130.

A natural therapist can easily access HTMA.

Urine Analysis

Urine analysis is used to screen for a variety of disorders. The tests check color and degree of cloudiness of the urine. They also detect and measure a variety of cells and substances in the urine. Examples are protein, sugar, liver products, blood cells, and in this case, levels of heavy metals. The findings can help diagnose diseases. In terms of heavy metals, the urine serves as a sample to assess the excretion of toxic elements, providing information on levels retained in the body and duration of exposure.⁶

Method of Sampling

The procedure is quite simple. There is usually no fluid or food restriction before the test. The patient collects a urine sample, either at home or at a medical clinic. If possible, the first urine (mid-stream) in the morning is collected. Alternatively it may be collected over a 24-hour period. The sample is then sent to a lab for analysis.

Variations of Urine Analysis

Pre and Post Provocative Testing

Provocative testing can help determine toxic element deposition and provide the clinician with clear therapeutic direction and accurate monitoring of treatment response. In this technique, a strong excretory inducer is administered to the patient after a pre-treatment urine sample is obtained. After a given time frame, dependent upon the agent used and the analytical technique applied, a second urine sample is collected and the post-treatment excretion of elements calculated. This method allows a sampling of the stored deposits of toxic elements, which have been sequestered from the blood.⁶

The Ionic Heavy Metal Test (IHMT)

The IHMT allows the detection of ionic and free radical producing metals (copper, zinc, iron, lead, mercury, cadmium etc.) in our environment and in our own body. The IHMT assesses the 'chelation ability' of a person from a small urine sample; it indicates how well an individual copes with ionic, electromagnetically active and free radical producing metals. The chelation ability in turn determines how many free radicals are produced. The IHMT does not detect chelated metals.⁷ In terms of the procedure, place 0.5 ml of TESSOL into a test tube. Then add the urine sample and shake. If the green TESSOL changes colour, it indicates that ionic metals are present. If it remains green, it means that ionic metals are not present in the sample. The type of ionic metals present can be seen by comparison with a colour chart. In the case of complex substances such as urine, these colours may vary from sample to sample. Urine may also carry a number of different metals, which would cause a mixed colour to appear.⁷

Accuracy and Considerations

Urine tests may fall short in terms of accuracy. This is because this source shows what elements the body is excreting, and not what is deposited or stored. While it provides good qualitative information if a person has been recently exposed to a toxic element (days to weeks), it is less reflective of long-term levels of mineral retention or losses. Also, concentrations of most elements in urine are usually significantly less when compared to other diagnostic samples like hair tissue.^{4,5} In addition, levels of nutrient elements in the excreted urine are tightly controlled via metabolic, reabsorptive, and excretory mechanisms. Consequently, urine testing may not be reliable in nutritional element assessment. In addition, since the urine sample can also be collected from home, it also runs the risk of contamination.

Cost: \$160 – \$170

A natural therapist would have to work with a GP to access this form of testing.

Blood Analysis

Blood Analysis is a simple procedure for obtaining an assessment of blood. From a tiny sample, highly magnified, the doctor can identify certain abnormalities of the blood and plasma. Light and dark-field microscopy then allows observations of multiple vitamin and mineral deficiencies, reduced immunity, heavy metal toxicity and free radical damage. Parasites, bacteria and yeast infections, blood and lymphatic congestion and stagnation, mal-absorption, malnutrition, aggregation and clotting and overall stress in the system may also be visible in the sample. Further diagnostic tests may be advised.⁸

Method of Sampling

Live and dry blood cell analysis is carried out by placing a drop of blood from the patient's fingertip on a microscope slide under a glass cover slip. The slide is then viewed at high magnification with a light-field, dark-field microscope. A video camera attached to the lens feeds the image through a video recorder and it is then displayed on a TV screen, for both the doctor and patient to view.⁸ Alternatively, a blood sample can be obtained from a peripheral vein, and sent to a lab for analysis.

Accuracy and Considerations

On the whole, blood analysis would not be as accurate as hair analysis as elemental concentrations in blood tend to be much less than that in hair and the blood shows only what is present at the moment the blood is drawn. In addition, unlike hair, blood tests do not reflect systemic levels of mineral content. While blood and serum do contain minerals, they are not completely representative of the body's mineral stores. In many cases, the serum level of minerals is transient in nature, and are subject to the body's homeostatic mechanisms to maintain levels within narrow ranges.^{4,5}

Furthermore, blood samples may give inaccurate data as serum concentrations may fluctuate with emotional changes, the time of day the blood is drawn, or foods eaten prior to taking a sample. For instance, serum magnesium can fluctuate depending upon the blood drawing technique. The longer the tourniquet is applied, the higher the magnesium rises as a result of tissue hypoxia. Blood levels can also vary according to the actual component analyzed – plasma, serum or red blood cells. They can be maintained at the expense of tissue concentration. Excess accumulation of minerals in the body are often undetected in the serum due to their removal from the blood for deposition into the tissues. For instance, 30 to 40 days after an acute exposure to toxic lead, elevated serum levels may be undetectable as a result of the body removing lead from the blood as a protective measure and depositing the metal into such tissues as the liver, bones, teeth and hair.^{4,5}

Cost : \$80 – \$170

A natural therapist can easily access live blood analysis, a full blood count would have to be obtained via a GP.

Test of Choice

My personal choice for testing heavy metal toxicity would be the Hair Tissue Mineral Analysis.

As mentioned several times, hair contains at least 10 times the concentration of elements as that of urine or blood. It is thus more reflective of the body's mineral stores and more likely to reveal toxicity than the other two methods. Also, unlike blood and urine, it does not just reflect the present level of mineral content, but is able to show the metabolic balance over a period of time. Moreover, it does not just pertain to a specific organ or tissue, but is reflective of the body's general condition. In addition, it is also less likely to be affected by immediate variables like emotional changes, time of the day when the sample is collected or the food eaten prior to collection.

From the view of a natural therapist, it is not only within easy access, but being relatively affordable, non-invasive and pain-free, it may also be easier to get the client to do the test.

Part 2: Heavy Metals

B. Chelation Therapy

Chelation Therapy

Chelation therapy is the administration of a drug that draws toxic metals from the bloodstream so that the body can pass them more effectively in urine or faeces. Physicians have used chelation therapy since the 1950s to treat heavy metal poisoning – primarily lead poisoning – and to remove metals that have built up in tissues as a result of such genetic disorders as Wilson's disease, cystinuria, and hemochromatosis. Chelation therapy is generally only recommended when high levels of metal are present in the blood, since it does not seem to benefit those with lower levels. In the case of heavy metal poisoning, removing the patient from the toxic environment is as important for successful recovery as chelation therapy. ¹

Benefits of Chelation Therapy

Chelation therapy is widely used for the treatment of atherosclerosis and other chronic degenerative diseases involving the circulatory system. It also has other benefits. Many scientists suggest that the beneficial effect of chelation treatment is from the removal of metallic catalysts that causes excessive free radical proliferation. This reduces the oxidation of lipids, DNA, enzyme systems and lipoproteins. The chelation halts the bad effects and initiates the body's healing process, often reversing the damage. It removes the calcium and copper anions from the blood stream. The plaque lining the artery walls are made porous and brittle. Eventually they may get dislodged. Even if only a microscopic layer of the plaque is removed, it, along with a smoothing of the artery wall due to the healing of the cells that line the arteries, can improve the blood flow to the artery muscles substantially. This can prevent artery spasm and minimize or prevent angina pain. Many patients who could not walk due to muscle pain or angina pain have reported that they can walk without pain after chelation therapy. ²

Forms of Chelation Therapy

Chelating agents are available in over-the-counter formulas that can be taken orally at home. Alternatively they are available as intravenous solutions that must be administered under the supervision of a physician. Oral chelating agents can often prevent problems from occurring by restoring circulation to the body's tissues. If there are pre-existing serious health problems, intravenous chelation therapy is usually required.

Some forms of chelation therapy that are available in Australia include:

- Ethylenediamine Tetra-Acetic Acid (EDTA)
- 2, 3-Dimercapto-1-Propane Sulfonic Acid (DMPS)
- Meso-2, 3-Dimercaptosuccinic Acid (DMSA)
- British Anti-Lewisite (BAL)
- D-Penicillamine

Ethylenediamine Tetra-Acetic Acid (EDTA)

Chelation therapy using EDTA is the medically accepted treatment for lead poisoning. EDTA is injected intravenously in a medical setting, such as a clinic or a hospital. Once in the bloodstream, EDTA latches onto lead and other metals to form a compound that can be excreted in the urine. Other heavy metal toxicities treated with EDTA chelation therapy include mercury, arsenic, aluminum, chromium, cobalt, manganese, nickel, selenium, zinc, tin, and thallium. Chelating agents other than EDTA are also used to clear several of these substances from the bloodstream.³

Other uses for EDTA chelation include treatment of angina, gangrene, arthritis, multiple sclerosis, Parkinson's disease, psoriasis, and Alzheimer's disease. Individuals experiencing diminished sight, hearing, smell, co-ordination, and sexual potency have also reported improvements.⁴

EDTA is synthetic and not found naturally. Because there is concern that EDTA may deplete important vitamins and minerals, EDTA chelation therapy is often administered together with essential nutrients, including B vitamins, vitamin C, and magnesium.³

Intravenous EDTA for heavy metal toxicity is generally delivered over one to three hours. The recommended adult dosage varies depending on the size of the person and the amount of lead or other metal in the body. The usual dose is 2000 – 3000 mg, added to 500ml of a carrier solution, which is usually sterile water with a mixture of vitamins and minerals.³

The solution is infused slowly, one drop per second, in order to be safe. The half-life of EDTA in the body is one hour. Within 24 hours, 99% of the EDTA is removed from the body. The number of recommended treatments is usually between 20 and 40. They are given one to three times a week. Maintenance treatments can then be given at the rate of once or twice a month.⁴

Side Effects: High doses of calcium EDTA can cause kidney damage. However, this can be reversed when the patient stops taking the drug. High doses may also cause headache, fever, chills, nausea, and vomiting. An irregular heartbeat may also be experienced when this drug is rapidly injected into a vein.¹

Cost: \$90 – \$120 per treatment

Accessible by a natural therapist, but a referral from a GP is required.

2, 3-Dimercapto-1-Propane Sulfonic Acid (DMPS)

DMPS is manufactured by a German pharmaceutical corporation, Heyl Pharmaceutical, under the trade name Dimaval. It is a pharmaceutical compound specifically used for the detoxification of heavy metals. It works by chemically binding and, therefore, isolating toxic heavy metals. This binding process allows the body to secrete the toxins naturally, in urine. The compound DMPS strongly binds mercury and other toxic metals, including lead, silver, cadmium, nickel, arsenic, antimony and bismuth. It will also bind chromium, molybdenum, copper, zinc, manganese and gold. ⁵

DMPS is administered by intravenous infusion, which are given on a weekly basis. Total mercury detoxification can usually be completed after five to ten intravenous treatments. Certain individuals with particularly high mercury burdens may require numerous treatments over time. Those in any industry at risk for mercury exposure, such as dentistry, tend to have higher levels and may require significantly longer periods of detoxification treatment. ⁵

Because DMPS actively binds other essential minerals, it can also deplete the body's store of these compounds. For that reason, it is often necessary to give periodic IV maintenance therapy to replace the essential elements lost to usual DMPS therapy. In addition, while receiving the IV treatments of DMPS, it is best not to supplement with certain nutritional formulations that include glutathione, NAC or cysteine compounds. They can form complexes with DMPS that render the DMPS less effective in removing heavy metals from the body. ⁵

Side Effects: All of the effects are time-limited and disappear upon discontinuation of the DMPS medicine. They include a slight lowering of blood pressure, which can create symptoms of dizziness or general weakness. Skin rashes may occur. Some patients report feeling flu-like symptoms for some hours following initial DMPS administration, as the detoxification process begins to take effect. The potential for these flu-like symptoms diminishes significantly after subsequent DMPS treatments. ⁵

In general, one can expect that the DMPS will be cleared out of the body 6-12 hours after administration. However, the flu-like symptoms can last one to two days. These symptoms can generally be significantly improved by taking extra vitamin C. The usual recommended additional dose is 1,000-2,000 mg daily. NAC (approximately 600 mg twice daily) and glutathione (100 mg daily) can also be supplemented. Each of these compounds will help accelerate the detoxification phase of DMPS treatment. However, they should not be given until six hours after DMPS administration. ⁵

After completing the prescribed course of DMPS chelation infusion therapies, a mercury test will be repeated to ascertain that the total burden of toxic mercury has been decreased to a normal level. When the total body burden of mercury is decreased to a safe and acceptable range, the patient will be able to initiate an oral chelation therapy protocol to reduce the body burden to near zero. ⁵

Cost: \$170 – \$180 per treatment

Accessible by a natural therapist, but a referral from a GP is required.

Meso-2, 3-Dimercaptosuccinic Acid (DMSA)

DMSA is also known as Chemet, Succimer, or Captomer. DMSA is a water-soluble, sulfhydryl-containing compound, which is an effective oral chelator of heavy metals. Initial studies over forty years ago identified DMSA as an effective antidote to heavy metal poisoning. It was subsequently studied for twenty years in the People's Republic of China, Japan, and Russia before scientists in Europe and the United States "discovered" the substance and its potential usefulness in the mid-1970s. In addition to being a potent chelating agent for lead toxicity, this medication also binds with metals such as lead, arsenic and mercury, excreting them through the liver, kidneys and bowel. ^{6,7}

DMSA is a dithiol and an analogue of dimercaprol (BAL, British Anti-Lewisite), a lipid-soluble compound also used for metal chelation. DMSA's water solubility and oral dosing create a distinct advantage over BAL, which has a small therapeutic index and must be administered in an oil solution via painful, deep intramuscular injection. DMSA, on the other hand, has a large therapeutic window and is the least toxic of the dithiol compounds. ^{6,7}

DMSA comes in capsule form and is given orally. Care must be taken to drink six to eight glasses of water a day while receiving DMSA treatments. The amount of DMSA per treatment is calculated according to body weight. Other factors are also considered which may lower the prescribed treatment dose. The usual treatment plan is five days of DMSA oral consumption, followed by a seven-day break, and then a second five days of oral DMSA is taken. After each five day DMSA treatment period, vitamin/mineral IVs must be administered to replace loses as a result of the chelation treatment. An evaluation will be conducted and repeat series may be indicated. The evaluation of any chelation treatment involves a urine test, which is testing for excretion of heavy metals. ⁶

DMSA is the gentlest method of chelation of the three presented. It is considered safe for children in the proper doses. ⁶

Side Effects: Includes flu-like symptoms such as headache, rash, itching, tingling, dizziness and transient elevated liver enzymes. Also, a loss of appetite and a metallic taste in the mouth may be experienced. ^{1,6}

Cost: \$8.80 per tablet (packs of 40 tablets)

Accessible by a natural therapist, but a referral from a GP is required.

British Anti-Lewisite (BAL)

BAL is an old agent, first made available during World War II. It is the chelating agent of choice for lead, mercury, arsenic, and gold poisoning. It must be injected intra-muscularly, after which high levels in the blood are maintained for two hours; the dose is excreted within 6 to 24 hours. Therefore, in acute poisoning, it is recommended that injections be repeated every four hours in doses of three to five mg/kg of body weight.⁸

Approximately half the injected dose is excreted through the biliary system. Hepatic injury does require reduction in BAL dosage, although the drug is well tolerated in the presence of renal failure. With BAL chelation, lead is primarily excreted in the bowel, rather than through the kidneys and so it is the treatment of choice for individuals with kidney problems. It has been shown that combination therapy, using both BAL and EDTA, results in greater salvage in severe childhood lead poisoning with encephalopathy than does EDTA therapy alone. Combination BAL-EDTA therapy is recommended in all cases of severe acute intoxication, particularly when encephalopathy is present. BAL is also a good second-line drug, which should be used in the patient who is sensitive to EDTA. BAL should not be used for children with peanut allergies.⁸

Side Effects: Treatment may produce a mild fever, nausea and occasional vomiting, and an increase in liver enzymes. It also triggers a release of histamine in the body, so the patient will likely experience allergy-like symptoms, such as a runny nose and watery eyes that can be alleviated by anti-histamines.¹

Accessible by a natural therapist, but a referral from a GP is required.

D-Penicillamine

D-Penicillamine, another oral chelating agent, is also known by its trade name as Cuprimine[®] (Merck) and Depen Titratable[®] (Wallace) and comes in capsule form. It is used primarily for the treatment of rheumatoid arthritis and the treatment of kidney stones. D-Penicillamine has also been used in the treatment of plumbism or lead poisoning. This drug can lower body stores of mercury, copper, and iron as well.⁹

When D-Penicillamine is used to treat arthritis, lymphocyte function is improved and IgM rheumatoid factor and serum immune complexes are reduced. It is also used to treat Wilson's disease, a rare inherited disorder that causes excess quantities of copper to accumulate in the body.⁹

The adult dosage of D-Penicillamine as a chelating agent is 250 mg capsules four times daily. For infants over 6 months of age and young children, the chelating dosage is 250 mg daily. Penicillamine capsules can be broken and given with fruit juice. Vitamin B6 (pyridoxine) 250 mg daily is recommended for people with impaired nutrition.⁹

In the United States, penicillamine is recognized as a third-line of treatment to be used only when unacceptable reactions have occurred following therapy with DMSA or calcium EDTA.⁹

Side Effects: D-Penicillamine can cause an allergic reaction, especially in individuals with a sensitivity to penicillin. Those with penicillin allergies should not be administered this drug.¹

Cost: \$20 – \$30

Accessible by a natural therapist, but a referral from a GP is required.

General Side Effects of Chelation Therapy

A number of side effects have been observed with chelation therapy. These may include:

Headaches

This is generally from a low blood sugar level. To prevent this from happening, eat before or during the treatment. A common recommendation for the prevention of the 'EDTA-headaches' is to eat a semi to ripe banana during the first hour of infusion.²

Local skin irritation

This is generally from a deficiency in zinc and vitamin B₆. Supplementation of these nutrients are recommended during the therapy.²

Nausea or stomach upset

Generally due to a deficiency of vitamin B₆. It is manifested in less than 1 percent of the patients receiving chelation therapy. It is best treated by B₆ supplementation, although short-term relief (up to eight hours) from nausea can be achieved by acupressure treatment.²

Diarrhoea

This occurs very rarely. Eat a diet that consists of plenty of liquids. Avoid spicy food. Frequency of urination goes up as the kidney efficiency improves. A weight loss from fluid excretion of 1.3 – 2.2 kg is common after an infusion especially if the patient suffered from fluid retention before chelation therapy.²

Fainting

This is generally due to a drop in blood pressure. It is common for those who had high blood pressure that returns to more normal levels as a result of the treatment. If the blood pressure was normal to start with, it could drop slightly after the infusion. This may lead to feeling of faintness on standing after sitting or lying. If this happens, rest for an hour or so. Keep your feet higher than your head so as to allow the blood to flow into the brain. Take a supplement containing the amino acid tyrosine to help restore normal pressure levels if this symptom persists.²

Extreme fatigue

This is usually from a general nutrient deficiency of minerals such as magnesium, zinc or potassium. Taking a potassium rich supplements and/or the regular eating of potassium rich foods are suggested before and during chelation as this mineral may be removed during the chelation therapy.²

Fever

A few people may develop fever the day after chelation therapy sessions. This condition left alone, normally resolves on its own.²

Cramps

About 5 percent of patients report cramps, usually at night. Administering supplemental magnesium either orally or as an additive to EDTA infusion mixture best treats it. If magnesium is added to the infusion, it is generally in the form of magnesium chloride or magnesium sulfate. Such additions also reduce the chance of local skin irritation at the site of the infusion.²

Pain in the joints

This is generally reported by patients who take frequent infusions. If this happens, reduce the number of infusions to one per week. The therapist may also reduce the dosage administered, if strong flu-like aches develop.²

Supportive Therapies

There is no substitute for prompt professional medical attention in cases of heavy metal toxicity. However, there are dietary measures that are beneficial, protective, and supportive of good health and the body's own natural chelation mechanisms. Many herbs and supplements have natural chelating characteristics and properties that help to detoxify the body. Important supplements to consider are antioxidants, herbs, minerals, essential amino acids, phytoextracts, detoxifying agents, protective agents, and fibre.

Antioxidants

Vitamin C

- ♦ Improves immune function, maintains healthy skin and blood vessels, accelerates healing, and reduces allergic reactions.¹⁰

Vitamin E

- ♦ Some of the benefits of vitamin E include synergy with vitamin A; reducing cellular aging; reducing the risk of Alzheimer's disease; protecting the nervous system; preventing abnormal blood clotting; lowering the risk of heart disease; protecting immune function; lowering the risk of certain cancers; and protecting the lungs from toxins and pollutants.
- ♦ Complete protection from muscle lesions produced by copper, cobalt, tellurium, cadmium, and zinc.
- ♦ Protection against lesions caused by silver.
- ♦ Reduces lipid peroxidation and cell death on liver cells caused by iron (ferrous sulfate).¹⁰

Vitamin A

- ♦ Essential for normal cell growth and protection from various diseases.
- ♦ A powerful antioxidant that destroys free radicals.¹⁰

Alpha-Lipoic Acid

- ♦ A potent free radical scavenger that has an ability to detoxify metals and regenerate other antioxidants, such as vitamins C and E, coenzyme Q10, and glutathione.
- ♦ Positive effects for cadmium toxicity, providing a protective effect for cadmium-induced cell dysfunction and membrane damage in hepatocytes.¹⁰

Glutathione

- ♦ Modulator of cellular homeostasis, including detoxification of oxyradicals and carcinogens.
- ♦ Increases the body's ability to handle heavy metals such as cadmium, lead, iron, and mercury.
- ♦ Important component of cellular resistance to arsenite and antimony.
- ♦ Glutathione is also closely tied to immunity, protecting the cells and assisting the liver in detoxifying harmful compounds and toxins.
- ♦ When taking glutathione, vitamin C is also recommended because vitamin C assists glutathione in maintaining its powerful free radical-suppressing effects.¹⁰

Lactoferrin

- ♦ An iron-binding protein, it acts as an antioxidant, scavenging free iron and helping to prevent uncontrolled iron-based free radical reactions.
- ♦ Both an iron scavenger and donor, it has been found to scavenge or donate iron appropriately depending on what the body needs at any given time.¹⁰

L-cysteine

- ♦ Act as antioxidant, has a pivotal role in inducible detoxification mechanisms in the body. ¹⁰

N-acetyl-cysteine (NAC)

- ♦ Acetylated form of L-cysteine, which is more efficiently absorbed and used.
- ♦ Works in the extracellular environment and is a precursor of intracellular cysteine and glutathione.
- ♦ Used as a liver protectant, as well as to break up pulmonary and bronchial mucus.
- ♦ Antioxidant activity, anti-inflammatory activity, immunological effects, inhibits progression to malignancy, inhibits metastasis, and protection from the adverse effects of chemopreventive and chemotherapeutic agents.
- ♦ When taking L-cysteine or NAC, taking vitamin C will help maintain their powerful free radical-suppressing effects. ¹⁰

Glycine

- ♦ Combines with many toxic substances and converts them to harmless forms, which are then excreted from the body.
- ♦ Reduces the oxidative stress of chronic cadmium toxicity. ¹⁰

Selenium and Zinc

- ♦ Act as cofactors of antioxidant enzymes to protect against oxygen free radicals produced during oxidative stress.
- ♦ Deficiency contributes to compromised immunity and lowered defense against free radicals. ¹⁰

Calcium

- ♦ Protects against the uptake of heavy metals such as cadmium and lead in the small intestine, bone and kidney. ¹⁰

Cilantro

- ♦ The essential oils have antifungal and antibacterial properties, works synergistically with antibiotic drugs to rapidly reduce symptoms and infection.
- ♦ Eliminates mercury deposits.
- ♦ Accelerated the elimination of mercury, lead, and aluminum through the urine. ¹⁰

Garlic

- ♦ A potent antioxidant, it provides protection from various pollutants and heavy metals. ¹⁰

Green Tea

- ♦ A powerful antioxidant that protects cells from mutation caused by cancer-causing agents and damage caused by free radicals. ¹⁰

Detoxifying Agents

Alfalfa

- ♦ High in vitamins A, D, E, B₆, and K; calcium, magnesium, chlorophyll, phosphorus, iron, potassium, trace minerals; and several digestive enzymes.
- ♦ Alfalfa is also a high-fiber substance; because of its high-fiber content, it has properties to bind to material in the colon and aid in its removal.
- ♦ Alfalfa should not be taken by individuals with toxic or chronic iron overload. ¹⁰

Chlorella

- ♦ Rich in protein, vitamins, minerals, chlorella growth factor, and other beneficial substances.
- ♦ A detoxifier that is commonly used in colon cleansing regimens. It binds to heavy metals as well as other toxic substances in the bowel and help with the detoxification process.
- ♦ Increased elimination of cadmium: threefold in faeces and sevenfold in urine.
- ♦ Detoxifies uranium and lead.
- ♦ Detoxification potential for similar compounds, such as dioxin and polychlorinated biphenyls.
- ♦ Detoxification of high levels of mercury in the body caused by removal of mercury amalgam. ¹⁰

MSM (Methylsulfonylmethane)

- ♦ Chelation involves a sulfur donor; because MSM is a compound that contains sulfur, theoretically it could be beneficial as a part of a detoxification protocol for heavy metals.
- ♦ Potential for allergy response reduction, control of hyperactivity, constipation relief, cancer prevention, and inflammatory conditions, such as rheumatoid and degenerative arthritis. ¹⁰

Rutin

- ♦ Antioxidant, anti-inflammatory, anticarcinogenic, and cytoprotective activities.
- ♦ Free-radical scavenging and iron-chelating ability that protects against cellular damage. ¹⁰

Dietary Fiber

Choosing foods with high fiber content and supplementing the diet with additional fiber aid the body in ridding itself of toxins. High fibre foods include psyllium, apple pectin, and oat and wheat bran. ¹⁰

Protective Agents

S-adenosylmethionine (SAME)

- ♦ As a preventive agent, SAME is so powerful that it can reverse the destructive effects of chemicals and alcohol as they occur.
- ♦ Plays a leading role in liver regeneration.
- ♦ SAME performs two crucial functions in the liver: methylation and trans-sulfuration. One result of trans-sulfuration is a transformation into glutathione, the liver's most vital substance. Glutathione is crucial for liver function and is a natural antioxidant for the liver.
- ♦ Aids elimination of cadmium and lead from the blood, liver and kidneys. ¹⁰

Silibinin

- ♦ Most biologically active ingredient in silymarin, an extract derived from *Silybum marianum*.
- ♦ Helps prevent toxic liver damage.
- ♦ An adjunct for liver, kidney, pancreas, and other organ support in any heavy metal detoxification program. The importance of silibinin for heavy metal detoxification lies in its ability to aid liver function and regeneration, elevate glutathione enzyme levels, reduce oxidation, and improve cellular thiol status.
- ♦ Accelerates the rate of protein synthesis in the liver, leading to faster cell regeneration.
- ♦ Protects the kidneys from toxic injury and produces accelerated kidney regeneration after toxic damage. ¹⁰

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* Prices quoted for heavy metal toxicity tests and chelation therapies were provided by:

- Australian Biologics Testing Services – Fayworth House, 383 Pitt Street, Sydney, NSW 2000.
- Chelation Clinic-Omnicare – 15 South Steyne, Manly, NSW 2095.
- InterClinical Laboratories – PO Box 630, Gladesville, NSW 2111.