HAIR ELEMENTS

LAB#: H000000-0000-0
PATIENT: Sample Patient
SEX: Female
AGE: 44

CLIENT#:
DOCTOR:

POTENTIALLY TOXIC ELEMENTS

TOXIC ELEMENTS	RESULT µg/g	REFERENCE RANGE	PERCENTILE (68th, 95th)
Aluminum	22	< 7.0	
Antimony	0.011	< 0.050	
Arsenic	0.019	< 0.060	
Beryllium	< 0.01	< 0.020	
Bismuth	0.020	< 0.10	
Cadmium	0.010	< 0.10	
Lead	7.9	< 1.0	
Mercury	3.2	< 1.1	
Platinum	< 0.003	< 0.005	
Thallium	< 0.001	< 0.010	
Thorium	< 0.001	< 0.005	
Uranium	0.013	< 0.060	
Nickel	0.57	< 0.40	
Silver	0.18	< 0.15	
Tin	0.11	< 0.30	
Titanium	0.48	< 1.0	
Total Toxic Representation			

ESSENTIAL AND OTHER ELEMENTS

ELEMENTS	RESULT µg/g	REFERENCE RANGE	PERCENTILE (2.5th, 16th, 50th, 84th, 97.5th)
Calcium	371	300- 1200	
Magnesium	210	35- 120	
Sodium	45	12- 90	
Potassium	7	8- 38	
Copper	670	12- 35	
Zinc	150	140- 220	
Manganese	0.91	0.15- 0.65	
Chromium	0.34	0.20- 0.40	
Vanadium	0.082	0.018- 0.065	
Molybdenum	0.025	0.028- 0.056	
Boron	0.74	0.30- 2.0	
Iodine	0.60	0.25- 1.3	
Lithium	< 0.004	0.007- 0.023	
Phosphorus	146	160- 250	
Selenium	0.86	0.95- 1.7	
Strontium	4.2	0.50- 7.6	
Sulfur	46100	44500- 52000	
Barium	0.61	0.26- 3.0	
Cobalt	0.017	0.013- 0.050	
Iron	13	5.4- 14	
Germanium	0.032	0.045- 0.065	
Rubidium	0.009	0.007- 0.096	
Zirconium	0.68	0.020- 0.42	

SPECIMEN DATA

COMMENTS:

Date Collected:	7/3/2006	Sample Size:	0.199 g
Date Received:	7/8/2006	Sample Type:	Head
Date Completed:	7/11/2006	Hair Color:	Blond
		Treatment:	Bleach
Methodology:	ICP-MS	Shampoo:	Melaluca

V06.99

RATIOS

ELEMENTS	RATIOS	EXPECTED RANGE
Ca/Mg	1.77	4- 30
Ca/P	2.54	1- 12
Na/K	6.43	0.5- 10
Zn/Cu	0.224	4- 20
Zn/Cd	> 999	> 800

HAIR ELEMENTS REPORT
INTRODUCTION

Hair is an excretory tissue for essential, nonessential and potentially toxic elements. In general, the amount of an element that is irreversibly incorporated into growing hair is proportional to the level of the element in other body tissues. Therefore, hair elements analysis provides an indirect screening test for physiological excess, deficiency or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly potentially toxic elements such as cadmium, mercury, lead and arsenic, are highly correlated with pathological disorders. For such elements, levels in hair may be more indicative of body stores than the levels in blood and urine.

All screening tests have limitations that must be taken into consideration. The correlation between hair element levels and physiological disorders is determined by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms and pathological conditions. It is also very important to keep in mind that scalp hair is vulnerable to external contamination of elements by exposure to hair treatments and products. Likewise, some hair treatments (e.g. permanent solutions, dyes, and bleach) can strip hair of endogenously acquired elements and result in false low values. Careful consideration of the limitations must be made in the interpretation of results of hair analysis. The data provided should be considered in conjunction with symptomology, diet analysis, occupation and lifestyle, physical examination and the results of other analytical laboratory tests.

Caution: The contents of this report are not intended to be diagnostic and the physician using this information is cautioned against treatment based solely on the results of this screening test. For example, copper supplementation based upon a result of low hair copper is contraindicated in patients afflicted with Wilson’s Disease.

Aluminum High

The Aluminum (Al) level in hair is a reliable indicator of assimilation of this element, provided that hair preparations have not added exogenous Al. Al is a nonessential element that can be toxic if excessively assimilated into cells.

Excess Al can inhibit the formation of alpha-keto glutarate and result in toxic levels of ammonia in tissues. Al can bond to phosphorylated bases on DNA and disrupt protein synthesis and catabolism. Al excess should be considered when symptoms of presenile dementia or Alzheimer’s disease are observed. Hair Al is commonly elevated in children and adults with low zinc and behavioral/learning disorders such as ADD, ADHD and autism. Individuals with renal problems or on renal dialysis may have elevated Al.

Possible sources of Al include some antacid medications, Al cookware, baking powder, processed cheese, drinking water, and antiperspirant components that may be absorbed. Analyses performed at DDI indicate extremely high levels of Al are in many colloidal mineral products.

Al has neurotoxic effects at high levels, but low levels of accumulation may not elicit immediate symptoms. Early symptoms of Al burden may include: fatigue, headache, and symptoms of phosphate depletion.

A urine elements test can be used to corroborate Al exposure. Al can be effectively complexed and excreted with silicon (J. Environ. Pathol. Toxicol. Oncol., 13(3): 205-7, 1994). A complex of malic acid and Mg has been reported to be quite effective in lowering Al levels (DDI clients).

Lead Extremely High

This individual's hair Lead (Pb) level is considered to be extremely elevated and is consistent with toxicity. Hair is an excellent indicator of the body burden of Pb. However, elevated levels of Pb in head hair can be an artifact of hair darkening agents, or dyes, e.g., lead acetate. Although these agents can cause exogenous contamination, transdermal absorption can contribute to body burden. Hair levels of iron, boron, zinc, and calcium are commonly elevated in associated with Pb burden. Chelation therapy results in marked, transient increases in hair Pb during mobilization from deep tissue stores. Eventually, the hair Pb level will normalize after detoxification is complete.

Pb has neurotoxic and nephrotoxic effects and interferes with heme biosynthesis. Pb may also affect the body's ability to utilize the essential elements calcium, magnesium, and zinc. At high levels of body burden, Pb may have adverse effects on memory and cognitive abilities, nerve conduction, and metabolism of vitamin D. Impaired erythropoiesis and anemia may be present. Children with hair Pb levels above 3 µg/g have been reported to have more learning problems than those with less than 3 µg/g (Arch. Environ. Hlth. 51: 214-220, 1996).

Symptoms associated with excess Pb are vague, but include: loss of appetite and body weight, poor memory, fatigue, constipation, headaches, inability to concentrate, and decreased coordination.

Sources of exposure to Pb include: welding, old leaded paint (dust/chips), drinking water, some fertilizers, industrial waste, lead-glazed pottery, manufacture of stained glass, and newsprint.

Confirmatory tests for Pb excess are: urine elements analysis following provocation with intravenous EDTA, DMPS, or oral DMSA. Whole blood analysis only reflects recent or ongoing exposures and may not correlate with total body burden. Increased blood protoporphyrins is a finding consistent with Pb excess, but may occur with other toxic elements as well.

Mercury High

Mercury (Hg) is toxic to humans and animals. The accumulation of Hg in the body is generally reflected by the hair Hg levels, but hair Hg levels can be artifactually high in association with the use of certain hair dyes. Individuals vary greatly in sensitivity and tolerance to Hg burden.

At hair levels below 3 µg/g, Hg can suppress biological selenium function and may cause or contribute to immune dysregulation in sensitive individuals. Hallmark symptoms of excess Hg include: loss of appetite, decreased senses of touch, hearing, and vision, fatigue, depression, emotional instability, peripheral numbness and tremors, poor memory and cognitive dysfunction, and neuromuscular disorders. Hair Hg has been reported to correlate with acute myocardial infarction and on average each 1 µg/g of hair Hg was found to correlate with a 9% increase in AMI risk (Circulation 1995; 91:645-655).

Sources of Hg include dental amalgams, contaminated seafood, water supplies, some hemorrhoidal preparations, skin lightening agents, instruments (thermometers, electrodes, batteries), and combustion of fossil fuels, some fertilizers, and the paper/pulp and gold industries. After dental amalgams are installed or removed a transient (several months) increase in hair Hg is observed. Also, ”baseline” hair Hg levels for individuals with dental amalgams are higher (about 1 to 2 µg/g) than are baseline levels for those without (below 1 µg/g).

Confirmatory tests for elevated Hg are measurement of whole blood as an indication of recent/ongoing exposure (does not correlate with whole body accumulation) and measurement of urine Hg following use of a dithiol chelating or mobilizing agent such as DMSA or DMPS (an indication of total body burden).

Nickel

Hair is a reasonable tissue for monitoring accumulated body stores of Nickel (Ni). However, hair is commonly contaminated with Ni from hair treatments and dyes. When hair Ni is measured at more than .6 ppm, the possible use of hair dyes or colorings should be investigated before concluding that excessive Ni is present.

There is substantial evidence that Ni is an essential element which is required in extremely low amounts. However, excess Ni has been well established to be nephrotoxic, and carcinogenic. Elevated Ni is often found in individuals who work in the electronic and plating, mining, and steel manufacture industries. A cigarette typically contains from 2 to 6 mcg of Ni; Ni is absorbed more efficiently in the lungs than in the gastrointestinal tract. Symptoms of chronic Ni exposure include dermatitis, chronic rhinitis, and hypersensitivity reactions. Ni can hypersensitize the immune system, subsequently causing hyperallergenic responses to many different substances.

Symptoms of Ni toxicity are dermatitis and pulmonary inflammation (following exposure to Ni dust, smoke). Long term or chronic Ni toxicity may lead to liver necrosis and carcinoma.

A confirmatory test for elevated Ni is the measurement of urine Ni before and after administration of chelating agents that mobilize Ni i.e., D-penicillamine, EDTA.

Silver High

Hair Silver (Ag) levels have been found to reflect environmental exposure to the element. However, hair is commonly contaminated with Ag from hair treatments such as permanents, dyes, and bleaches.

Ag is not an essential element and is of relatively low toxicity. However, some Ag salts are very toxic.

Sources of Ag include seafood, metal and chemical processing industries, photographic processes, jewelry making (especially soldering), effluents from coal fired power plants and colloidal silver products.

The bacteriostatic properties of Ag have been long recognized and Ag has been used extensively for medicinal purposes; particularly in the treatment of burns. There is much controversy over the long term safety of consumption of colloidal silver. Very high intake of colloidal silver has been reported to give rise to tumors in the liver and spleen of animals (Metals in Clinical and Analytical

Chemistry, eds. Seiler, Segel and Segel, 1994). However, these data may not have relevance to the effects of chronic, low level consumption by humans.

Magnesium High

Magnesium (Mg) is an essential element with both electrolyte and enzyme-activator functions. However, neither of these functions takes place in hair. Body excess of Mg is rare but may occur from excessive oral or parenteral supplementation or as a result of renal damage or insufficiency.

If one rules out external contamination of hair as a result of recent hair treatment, elevated hair Mg is more likely to indicate maldistribution of the element. Physiological Mg dysfunction may or may not be present. Maldistribution of Mg can occur as a result of chronic emotional or physical stress, toxic metal or chemical exposure, physiological imbalance of calcium and phosphorus, bone mineral depletion, and renal insufficiency with poor clearance of Mg (and other metabolites). Elevated hair Mg has been correlated with hypoglycemia and an inappropriately low ratio of dietary Ca : P.

Mg status can be difficult to assess; whole blood and packed blood red cell Mg levels are more indicative than serum/plasma levels Amino acid analysis can be helpful in showing rate-limited steps that are Mg-dependent (e.g. phosphorylations).

Potassium Low

The level of Potassium (K) in hair does not reflect nutritional status or dietary intake. However, hair K levels may provide clinically relevant information pertaining to adrenal function and/or electrolyte balance.

K is an electrolyte and a potentiator of enzyme functions in cells, but neither of theses functions takes place in hair. K can be low in the body as the result of gastrointestinal or renal dysfunction, or as a side effect of some diuretics. In adrenocortical hyperactivity, blood levels of K are depressed, while urinary K is increased. Low hair K should be viewed as a screening test. Observations at DDI indicate that hair levels of sodium and K are commonly low in association with emotional stress. The low levels of sodium and K are frequently concomitant with high levels of calcium and magnesium in hair. This apparent ”emotional stress pattern” requires further investigation.

Symptoms of true K deficiency include: muscle weakness, fatigue, and tachycardia. Diabetic acidosis can result in severe K loss.

Confirmatory tests for K deficiency include measurements of packed red blood cell K; whole blood K and the sodium/K ratio; urine K and the sodium/K ratio. An electrocardiogram may show abnormalities when K is low in serum/plasma or whole blood.

Copper High

The high level of Copper (Cu) in hair may be indicative of excess Cu in the body. However, it is important first to rule out exogenous contamination sources: permanent solutions, dyes, bleaches, swimming pool/hot tub water, and washing hair in acidic water carried through Cu pipes. In the case of contamination from hair preparations, other elements (aluminum, silver, nickel, titanium) are usually also elevated.

Sources of excessive Cu include contaminated food or drinking water, excessive Cu supplementation, and occupational or environmental exposures. Insufficient intake of competitively absorbed elements such as zinc or molybdenum can lead to, or worsen Cu excess.

Medical conditions that may be associated with excess Cu include: biliary obstruction (reduced ability to excrete Cu), liver disease (hepatitis or cirrhosis), and renal dysfunction. Symptoms associated with excess Cu accumulation are muscle and joint pain, depression, irritability, tremor, hemolytic anemia, learning disabilities, and behavioral disorders.

Confirmatory tests for Cu excess are a comparison of Cu in pre vs. post provocation (D-penicillamine, DMPS) urine elements tests and a whole blood elements analysis.

Manganese High

Hair Manganese (Mn) levels generally reflect actual body stores, but external contamination can influence hair Mn. High hair Mn can be an artifact of contamination from: permanent solutions, dyes, bleaches, and well water (containing high Mn). These possibilities should be considered and ruled out before proceeding with therapies to alleviate excess Mn.

Mn is an essential element which is involved in the activation of many important enzymes. However, Mn excess is postulated to result in glutathionyl radical formation, reduction of the free glutathione pool, and increased exposure of adrenal catecholamines (e.g. dopamine) to free radical damage. Excess Mn causes degeneration of myelin pigmented dopaminergic neurons which results in abnormally low levels of serotonin and dopamine in the brain. This is hypothesized to be a reason behind the neurotoxic effects attributed to Mn overload.

The brain is particularly affected by Mn excess. Symptoms or conditions consistent with excessive Mn include: disorientation, memory loss, anxiety, emotional instability, and bipolar-like behaviors (laughing and crying), aberrant or violent behaviors, and tremor or Parkinson-like symptoms.

Causes of Mn excess include: occupational or environmental exposures, contaminated teas, contaminated drinking water, some street drugs (cocaine products), and smoking. Conditions predisposing to Mn excess are: iron or calcium deficiency, chronic infection, and impaired liver or kidney function. Mn excess is occasionally associated with alcoholism.

Confirmatory tests for Mn excess include whole blood and provoked urine elements (e.g. EDTA, DMPS).

Vanadium High

High levels of Vanadium (V) in hair may be indicative of excess absorption of the element. It is well established that excess V can have toxic effects in humans. Although it appears that V may have essential functions, over zealous supplementation is not warranted.

Excess levels of V in the body can result from chronic consumption of fish, shrimp, crabs, and oysters derived from water near offshore oil rigs (Metals in Clinical and Analytical Chemistry, 1994). Industrial/environmental sources of V include: processing of mineral ores, phosphate fertilizers, combustion of oil and coal, production of steel, and chemicals used in the fixation of dyes and print.

Symptoms of V toxicity vary with chemical form and route of absorption. Inhalation of excess V may produce respiratory irritation and bronchitis. Excess ingestion of V can result in decreased appetite, depressed growth, diarrhea/gastrointestinal disturbances, nephrotoxic and hematotoxic effects. Pallor, diarrhea, and green tongue are early signs of excess V and have been reported in human subjects consuming about 20 mg V/day (Modern Nutrition in Health and Disease, 8th edition, eds. Shils, M., Olson, J., and Mosha, S., 1994).

Confirmatory tests for excess V are red blood cell elements analysis, and urine V which reflects recent intake.

Molybdenum Low

Low Molybdenum (Mo) in hair is a possible indication of Mo deficiency. Hair is very rarely contaminated with exogenous Mo.

Mo is an essential trace element that is an activator of specific enzymes such as: xanthine oxidase (catalyzes formation of uric acid), sulfite oxidase (catalyzes oxidation of sulfite to sulfate), and aldehyde dehydrogenase (catalyzes oxidation of aldehydes). Possible effects or symptoms consistent with Mo deficiency are: subnormal uric acid in blood and urine, sensitivity or reactivity to sulfites, protein intolerance (specifically to sulfur-bearing amino acids), and sensitivity or reactivity to aldehydes.

True Mo deficiency is uncommon but may result from: a poor-quality diet, gastrointestinal dysfunctions, or tungsten exposure. Tungsten (from ”TIG” welding) can be a powerful antagonist of Mo retention in the body. Copper overload can also reduce Mo retention.

Because normal blood and blood cell Mo levels are very low (a few parts per billion), blood measurement is not an appropriate tissue for confirmation of subnormal molybdenum.

Confirmatory tests for Mo deficiency include measurement of urine sulfite concentration (increased in Mo deficiency), measurement of blood/urine uric acid level (decreased in Mo deficiency), and measurement of urinary Mo content.

Lithium Low

Lithium (Li) is normally found in hair at very low levels. Hair Li correlates with high dosage of Li carbonate in patients treated for Affective Disorders. However, the clinical significance of low hair Li levels is not certain at this time. Thus, hair Li is measured primarily for research purposes. Anecdotally, clinical feedback to DDI consultants suggests that low level Li supplementation may have some beneficial effects in patients with behavioral/emotional disorders. Li occurs almost universally in water and in the diet; excess Li is rapidly excreted in urine.

Li at low levels may have essential functions in humans. Intracellularly, Li inhibits the conversion of phosphorylated inositol to free inositol. In the nervous system this moderates neuronal excitability. Li also influences monamine neurotransmitter concentrations at the synapse (this function is increased when Li is used therapeutically for mania or bipolar illness).

A confirmatory test for low Li is measurement of Li in blood serum/plasma.

Selenium Low

Selenium (Se) is normally found in hair at very low levels, and several studies provide evidence that low hair Se is reflective of dietary intake and associated with cardiovascular disorders. Utilization of hair Se levels to assess nutritional status, however, is complicated by the fact that use of Se- or sulfur-containing shampoo markedly increases hair Se (externally) and can give a false high value.

Se is an extremely important essential element due to its antioxidative function as an obligatory component of the enzyme glutathione peroxidase. Se is also protective in its capacity to bind and ”inactivate” mercury, and Se is an essential cofactor in the deiodination of T-4 to active T-3 (thyroid hormone). Some conditions of functional hypothyroidism therefore may be due to Se deficiency (Nature; 349:438-440, 1991); this is of particular concern with mercury exposure. Studies have also indicated significant inverse correlations between Se and heart disease, cancer, and asthma.

Selenium deficiency is common and can result from low dietary intake of Se or vitamin E, and exposure to toxic metals, pesticides/herbicides and chemical solvents.

Symptoms of Se deficiency are similar to that of vitamin E deficiency and include muscle aches, increased inflammatory response, loss of body weight, alopecia, listlessness, skeletal and muscular degeneration, growth stunting, and depressed immune function.

Confirmatory tests for Se deficiency are Se content of packed red blood cells, and activity of glutathione peroxidase in red blood cells.

Total Toxic Element Indication

The potentially toxic elements vary considerably with respect to their relative toxicities.
The accumulation of more than one of the most toxic elements may have synergistic adverse effects, even if the level of each individual element is not strikingly high. Therefore, we present a total toxic element ”score” which is estimated using a weighted average based upon relative toxicity. For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.