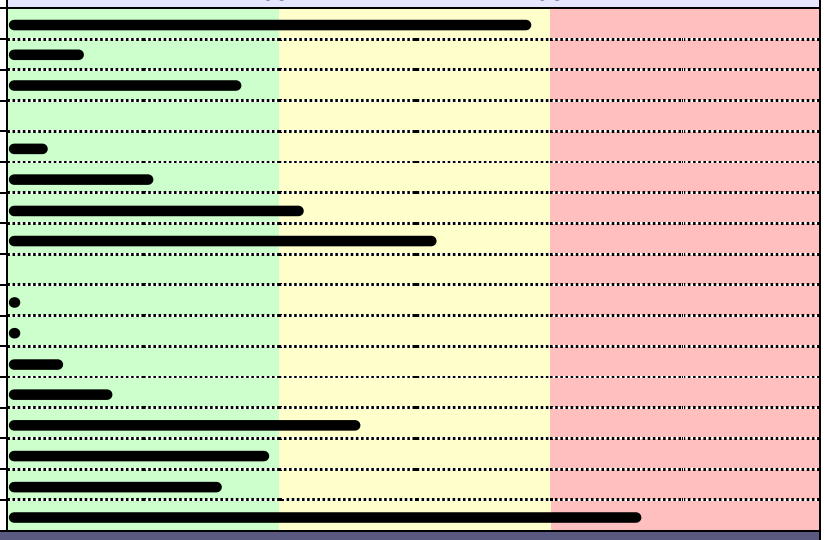
HAIR ELEMENTS

The Great Plains Laboratory, Inc.

LAB#:
PATIENT:
SEX: Male
AGE: 6
CLIENT#:

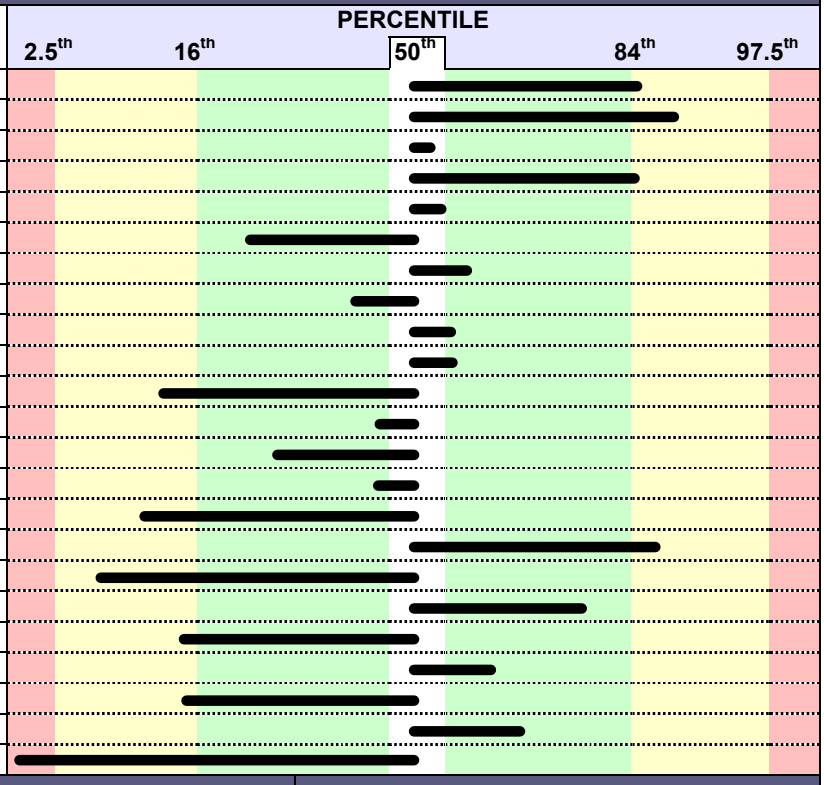
POTENTIALLY TOXIC ELEMENTS

TOXIC ELEMENTS	RESULT µg/g	REFERENCE RANGE
Aluminum	**22**	< 8.0
Antimony	**0.024**	< 0.066
Arsenic	**0.070**	< 0.080
Beryllium	**< 0.01**	< 0.020
Bismuth	**0.015**	< 0.12
Cadmium	**0.082**	< 0.15
Lead	**1.3**	< 1.0
Mercury	**1.4**	< 0.40
Platinum	**< 0.003**	< 0.005
Thallium	**0.001**	< 0.010
Thorium	**0.001**	< 0.005
Uranium	**0.011**	< 0.060
Nickel	**0.15**	< 0.40
Silver	**0.25**	< 0.13
Tin	**0.29**	< 0.30
Titanium	**0.79**	< 1.0
Total Toxic Representation		



ESSENTIAL AND OTHER ELEMENTS

ELEMENTS	RESULT µg/g	REFERENCE RANGE
Calcium	**564**	160- 500
Magnesium	**77**	12- 50
Sodium	**44**	12- 90
Potassium	**52**	10- 40
Copper	**17**	9.0- 30
Zinc	**120**	110- 190
Manganese	**0.37**	0.18- 0.60
Chromium	**0.28**	0.23- 0.50
Vanadium	**0.059**	0.025- 0.10
Molybdenum	**0.063**	0.040- 0.089
Boron	**0.41**	0.50- 3.5
Iodine	**0.50**	0.25- 1.3
Lithium	**0.008**	0.007- 0.023
Phosphorus	**193**	160- 250
Selenium	**0.78**	0.95- 1.7
Strontium	**3.1**	0.21- 2.1
Sulfur	**43000**	45500- 53000
Barium	**1.4**	0.19- 1.6
Cobalt	**0.012**	0.013- 0.035
Iron	**12**	6.0- 17
Germanium	**0.042**	0.045- 0.065
Rubidium	**0.051**	0.008- 0.080
Zirconium	**0.009**	0.060- 0.70



SPECIMEN DATA

COMMENTS: 0100827
Date Collected: 9/1/2006
Date Received: 9/13/2006
Date Completed: 9/16/2006

Methodology: ICP-MS

Sample Size: 0.201 g
Sample Type: Head
Hair Color:
Treatment:
Shampoo:

V06.99

RATIOS

ELEMENTS	RATIOS	EXPECTED RANGE
Ca/Mg	**7.32**	4- 30
Ca/P	**2.92**	0.8- 8
Na/K	**0.846**	0.5- 10
Zn/Cu	**7.06**	4- 20
Zn/Cd	**> 999**	> 800

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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 High

This individual's hair Lead (Pb) level is considered to be moderately elevated but below the levels consistent with Pb poisoning. Generally, 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, some transdermal absorption can contribute to body burden. Hair levels of iron, boron, calcium, and zinc are often concomitantly elevated with Pb burden.

Pb has neurotoxic and nephrotoxic effects in humans as well as interfering with heme biosynthesis. Pb may also affect the body's ability to utilize the essential elements calcium, magnesium, and zinc. At moderate levels of body burden, Pb may have adverse effects on memory, cognitive function, nerve conduction, and metabolism of vitamin D. Children with hair Pb levels greater than 1 µg/g have been reported to have a higher incidence of hyperactivity than those with less than 1 µg/g. 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. Detoxification therapy by means of chelation results in transient increases in hair lead. Eventually, the hair Pb level will normalize after detoxification is complete.

Symptoms associated with excess Pb are somewhat nonspecific, but include: anemia, headaches, fatigue, weight loss, cognitive dysfunction and decreased coordination.

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

Confirmatory tests for Pb excess are: urine elements analysis following provocation with intravenous EDTA , DMPS, or oral DMSA. Whole blood analysis for Pb only reflects recent or ongoing exposures and may not correlate with total body burden. Increased blood or urine 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).

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 High

High hair Potassium (K) is not necessarily reflective of dietary intake or nutrient status. However, elevated K may be reflective of metabolic disorders associated with exposure to potentially toxic elements.

K is an electrolyte and a potentiator of enzyme functions, but neither of these functions take place in hair. Elevated K in hair may reflect overall retention of K by the body or maldistribution of this element. In adrenocortical insufficiency, K is increased in blood, while it is decreased in urine; cellular K may or may not be increased. Also, hair is occasionally contaminated with K from some shampoos. Observations at DDI indicate that K and sodium levels in hair are commonly high in association with toxic element burden. The elevated K and sodium levels are often concomitant with low levels of calcium and magnesium in hair. This apparent phenomena requires further investigation.

Elevated hair potassium should be viewed as a screening test. Appropriate tests for excess body K include measurements of packed red blood cell K; serum or whole blood K and sodium/K ratio, measurement of urine K and sodium/K ratio; and an assessment of adrenocortical function.

Copper Normal

Hair Copper (Cu) levels are usually indicative of body status, except that exogenous contamination may occur giving a false normal (or false high). Common sources of contamination include: permanent solutions, dyes, bleaches, and swimming pools/hot tubs in which Cu compounds have been used as algaecides.

Cu is an essential element that activates specific enzymes. Erythrocyte superoxide dismutase (SOD) is a Cu (and zinc) dependent enzyme; lysyl oxidase which catalyzes crosslinking of collagen is another Cu dependent enzyme. Adrenal catecholamine synthesis is Cu dependent, because the enzyme dopamine beta-hydroxylase, which catalyzes formation of norepinephrine from dopamine, requires Cu.

If hair Cu is in the normal range, this usually means tissue levels are in the normal range. However, under circumstances of contamination, a real Cu deficit could appear as a (false) normal. If symptoms of Cu deficiency are present, a whole blood or red blood cell elements analysis can be performed for confirmation of Cu status.

Boron Low

Boron (B) is normally found in hair, but the correlations among dietary B intake, and tissue and hair levels of B have yet to be established. Recent studies clearly indicate that B has an important role in normal bone metabolism/density and may be needed for normal membrane function. In post-menopausal women consuming a very low B diet, B supplementation significantly lowered urinary excretion of calcium and magnesium and increased serum levels of estrogen (Environ. Health Persepct.; 102 Supl.7: 59-63, 1994). Further research is in process to determine the clinical significance of hair B levels.

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.

Strontium High

Hair usually reflects the body burden of Strontium (Sr), and Sr levels usually correlate with calcium levels in body tissue. However, hair levels of Sr can be raised by external contamination, usually from hair treatment products. Elevated Sr in hair treated with permanent solutions, dyes, or bleaches is likely to be an artifact of hair treatment and probably does not reflect the level of Sr in other tissues.

Diseases of excess Sr have not been reported, except for Sr rickets. In general, Sr excess is not of clinical concern in the U.S. It’s bad reputation comes from it’s radioactive isotopes which were widespread in the western U.S. as a result of nuclear testing in the 1950’s. Stable Sr (not radioactive Sr) is measured and reported by DDI.

Other tests indicative of Sr status or excess are measurements of Sr in whole blood, Sr/calcium ratio in blood, and Sr in urine.

Sulfur Low

Sulfur (S) in hair is covalently bound within the cysteinyl residues of hair protein. On average, cysteine constitutes about sixteen percent of the total amino acid content of hair. Although not well documented, hair S levels may vary with S-containing amino acid status in the body. Interpretation of hair S levels is confounded by the fact some hair conditioners and permanent treatments increase hair S while straighteners can significantly lower hair S levels.

Observations at DDI indicate that hair S and urine sulfhydryl amino acid levels are often low in Hg burdened patients.

Appropriate tests to determine sulfhydryl amino acid status are plasma or urine amino acid analyses.

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.