LAB #: H241017-2349-1
PATIENT: Shirin Bonshahi
ID: BONSHAHI-S-00002
SEX: Female
DOB: 07/03/1952 AGE: 72

CLIENT #: 24237
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Toxic & Essential Elements; Hair

TOXIC METALS		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 68th 95th
Aluminum	(Al)	12	< 7.0	
Antimony	(Sb)	< 0.01	< 0.050	
Arsenic	(As)	0.021	< 0.060	
Barium	(Ba)	0.51	< 2.0	
Beryllium	(Be)	< 0.01	< 0.020	
Bismuth	(Bi)	0.011	< 2.0	
Cadmium	(Cd)	< 0.009	< 0.050	
Lead	(Pb)	0.04	< 0.60	
Mercury	(Hg)	0.03	< 0.80	
Platinum	(Pt)	< 0.003	< 0.005	
Thallium	(Tl)	< 0.001	< 0.002	
Thorium	(Th)	< 0.001	< 0.002	
Uranium	(U)	0.061	< 0.060	
Nickel	(Ni)	0.04	< 0.30	
Silver	(Ag)	0.02	< 0.15	
Tin	(Sn)	0.02	< 0.30	
Titanium	(Ti)	0.15	< 0.70	
Total Toxic Representation				

ESSENTIAL AND OTHER ELEMENTS		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 2.5th 16th 50th 84th 97.5th
Calcium	(Ca)	742	300- 1200	
Magnesium	(Mg)	47	35- 120	
Sodium	(Na)	10	20- 250	
Potassium	(K)	10	8- 75	
Copper	(Cu)	17	11- 37	
Zinc	(Zn)	210	140- 220	
Manganese	(Mn)	0.06	0.08- 0.60	
Chromium	(Cr)	0.33	0.40- 0.65	
Vanadium	(V)	0.009	0.018- 0.065	
Molybdenum	(Mo)	0.015	0.020- 0.050	
Boron	(B)	0.40	0.25- 1.5	
Iodine	(I)	0.45	0.25- 1.8	
Lithium	(Li)	0.008	0.007- 0.020	
Phosphorus	(P)	171	150- 220	
Selenium	(Se)	0.81	0.55- 1.1	
Strontium	(Sr)	1.1	0.50- 7.6	
Sulfur	(S)	50300	44000- 50000	
Cobalt	(Co)	0.004	0.005- 0.040	
Iron	(Fe)	5.3	7.0- 16	
Germanium	(Ge)	0.030	0.030- 0.040	
Rubidium	(Rb)	0.016	0.007- 0.096	
Zirconium	(Zr)	0.011	0.020- 0.42	

SPECIMEN DATA

COMMENTS:

Date Collected: 10/15/2024
Date Received: 10/17/2024
Date Reported: 10/28/2024
Methodology: ICP/MS

Sample Size: 0.196 g
Sample Type: Head
Hair Color: Black
Treatment:
Shampoo:

RATIOS

ELEMENTS	RATIOS	RANGE
Ca/Mg	15.8	4- 30
Ca/P	4.34	1- 12
Na/K	1	0.5- 10
Zn/Cu	12.4	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 may be an indicator of exposure and 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).

Uranium High

The levels of Uranium (U) in hair usually reflect levels of U in other tissues. However, hair may be externally contaminated by shampoos or hair products that contain U.

U is a nonessential element that is very abundant in rock, particularly granite, lignite, monazite sands, and phosphate rocks. U is present at widely varying levels in drinking water, root vegetables, and present in high phosphate fertilizers. Other sources of U include: ceramics, some colored glass, many household products and tailings from U mines. Spent U rods have been milled into armor piercing bullets and missile heads.

Uranyl cations bind tenaciously to protein, phosphate, nucleotides, and bone, where it substitutes for Ca. Published data are sparse, but there appears to be a correlation between U exposure, nephrotoxicity and cancer. Kidney and bone are the primary sites of U accumulation.

All isotopes of U are radioactive; 238U is the most abundant and lowest energy emitter. It is important to note that the measured result, which is 238U, does NOT necessarily indicate or imply exposure to highly enriched 235U, which is used in nuclear power and weaponry.

Chronic fatigue is often reported in association with hair U levels >0.5 µg/g (DDI observations). U is rapidly cleared from blood and deposited in tissues. Currently, DTPA is the only effective chelating agent for ACUTE U poisoning. However, it must be administered immediately and is not effective once U has transferred from blood to tissues. Currently there are no available chelators or complexing agents that have been established to be effective for ameliorating U retention associated with long-term, low-level exposure to U.

Urine or fecal elements analysis can be performed to confirm recent or ongoing exposure to U. Because U is such a potent nephrotoxin, one might test for urinary wasting of amino acids and low molecular weight proteins (B-2-microglobulin) in patients with markedly elevated hair U levels.

Sodium Low

The level of Sodium (Na) in hair has not been documented to be indicative of dietary adequacy or nutritional status. Na is an essential element with extracellular electrolyte functions, but these functions do not occur in hair. Low hair Na may have no clinical significance or it may be consistent with electrolyte imbalance associated with adrenal insufficiency. In this condition, blood Na would be low, blood potassium would be high, and urinary levels of Na would be expected to be high. Observations at DDI indicate that Na and potassium levels in hair are commonly low in association with emotional stress. The low levels of Na and potassium are frequently concomitant with high levels of calcium and magnesium in hair. This apparent ”emotional stress pattern” requires further investigation.

Appropriate tests for Na status as an electrolyte are measurements of Na in whole blood and

urine, and measurements 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.

Manganese Low

Hair Manganese (Mn) levels correlate well with Mn levels in other body tissues. Hair Mn levels are commonly low, in part due to low dietary Mn intake and the interaction of Mn with phosphates in the gut. Intestinal malabsorption also limits Mn uptake.

Mn is an essential element that is involved in energy metabolism, and bone and cartilage formation. Mn is an activator of many important enzymes including: mitochondrial superoxide dismutase, arginase, and pyruvate carboxylase.

Symptoms associated with Mn deficiency include: fatigue, lack of physical endurance, slow growth of fingernails and hair, impaired metabolism of bone and cartilage, dermatitis, weight loss, and reduced fertility. Increased allergic sensitivities and inflammation are often associated with low Mn. Seizures are occasionally reported to be associated with severe Mn deficiency.

An appropriate laboratory test to confirm Mn deficiency is whole blood elements analysis.

Chromium Low

Hair Chromium (Cr) is a good indicator of tissue levels and may provide a better indication of status than do urine or blood plasma/serum (Nielsen, F.H. In Modern Nutrition on Health and Disease; 8th Edition, 1994. Ed. Shils, Olson and Shike. Lea and Febiger, Philadelphia). Hair Cr is seldom affected by permanent solutions, dyes and bleaches.

Cr (trivalent) is generally accepted as an essential trace element that is required for maintenance of normal glucose and cholesterol levels; it potentiates insulin function, i.e., as a part of ”glucose tolerance factor”. Deficiency conditions may include hyperglycemia, transient hyper/hypoglycemia, fatigue, accelerated atherosclerogenesis, elevated LDL cholesterol, increased need for insulin and diabetes-like symptoms, and impaired stress responses. Marginal or insufficient Cr is common in the U.S., where average tissue levels are low compared to those found in many other countries. Low hair Cr appears to

be associated with increased risk of cardiovascular disease and an atherogenic lipoprotein profile (low HDL, high LDL). Common causes of deficiency are ingestion of highly processed foods, inadequate soil levels of Cr, gastrointestinal dysfunction, and insufficient vitamin B-6. Cr status is also compromised in patients with iron overload/high transferrin saturation because transferrin is a major transport protein for Cr.

Confirmatory tests for Cr adequacy include glucose tolerance and whole blood cell elements analysis.

Vanadium Low

Vanadium (V) is typically found at low levels in hair and the clinical significance of the measured result of lower than average hair V is not known. V is measured in hair for research purposes because it has been postulated to be an essential microtrace element. Indirect data to support this postulate have been derived from experimental models. Suggested functions for V include: regulation of sodium-potassium-ATPase, intracellular glutathione metabolism, thyroid metabolism, and insulin mimetic effects at pharmacological doses.

Average dietary V intake varies considerably between 20 mcg to 2 mg. Food sources of V include: liver, fish, radishes, grains, nuts, and vegetable oils.

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.

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.