Test Requisition # Physician :



# 年齢

# Toxic & Essential Elements; Hair メタル& 必須要素検査;頭髪

重金属							
		検出量 μg/g	基準値	百分位	漤(パーセン 58 <sup>th</sup>	∨タイル) 95 <sup>th</sup>	
アルミニウム	(AI)	2.6	< 7.	0			
アンチモン	(Sb)	0.026	< 0.06	6 -			
と素	(As)	0.029	< 0.08	0			
バリウム	(Ba)	0.30	< 1.	0			
ベリリウム	(Be)	< 0.01	< 0.02	0			
ビスマス	(Bi)	0.032	< 2.	0			
カドミウム	(Cd)	< 0.009	< 0.06	5			
	(Pb)	0.25	< 0.8	0			
7K銀	(Ha)	1.5	< 0.8	0			
プラチナ	(Pt)	< 0.003	< 0.00	5			
<u>タリワム</u>	(TI)	0.001	< 0.00	2			
	(Th)	< 0.001	< 0.00	2			
	(U)	< 0.001	< 0.06	0			
ニッケル	(Ni)	0.12	< 0.2	0			
<u> </u>	(Ag)	0.04	< 0.0	8			
	(Sn)	0.05	< 0.3	0			
	(Ti)	0.17	< 0.6	0			
月 害重金属 総重 頁荷度							
	1	<u>必須ミネラルと</u>	その 他ミネ :	ラル			
		検出量	其淮佑	白分位 2.5 <sup>th</sup> 16 <sup>th</sup>	数(パーセン <sup>h</sup> 50 <sup>th</sup>	′タイル) 84 <sup>th</sup> 97.5 <sup>th</sup>	
カルシウム	(Ca)	545	200- 75	0			
マグネシウム	(Ma)	26	25- 7	5			
ナトリウム	(Na)	71	20- 18	0	•		
カリウム	(K)	130	9- 8	0			
銅	(Cu)	8.1	11- 3	0			
— <u>———</u> ————————————————————————————————	(Zn)	140	130- 20	0			
マンガン	(Mn)	0.08	0.08- 0.5	0			
クロム	(Cr)	0.37	0.40- 0.7	0 -			
バナジウム	(V)	0.022	0.018- 0.06	5			
モリブデン	(Mo)	0.038	0.025- 0.06	0	-		
ホウ素	(B)	1.2	0.40- 3.	0	•		
<u>ヨウ素</u>	(1)	0.43	0.25- 1.	8	-		
リチウム	(Li)	0.014	0.007- 0.02	0	-		
リン	(P)	164	150- 22	0	—		
セレン	(Se)	0.93	0.70- 1.	2	•		
ストロンチウム	(Sr)	0.73	0.30- 3.	5	-		
イオウ	(S)	43100	44000- 5000	0 💻			
コバルト	(Co)	0.003	0.004- 0.02	0	<b></b>		
鉄	(Fe)	5.7	7.0- 1	6 -			
ゲルマニウム	(Ge)	0.035	0.030- 0.04	0	•		
ルビジウム	(Rb)	0.20	0.011- 0.1	2			
ジルコニウム	(Zr)	0.013	0.020- 0.4	4			
	検体デ	— 夕			ミネラル比	率	
コメント・				ミネラル	十座	<b>煙淮</b> 箭田	
				Ca/Mq	21	4-30	
壬 虧 抵助日	¥	金休量		Ca/P	3.32	0.8- 8	
▲ 小 和 日	和	英体種類: Head		Na/K	0.546	0.5-10	
AA在完了日 ICP/MS		髪の染色		Zn/Cu	17.3	4-20	
	ĥ	リートメント:		Zn/Cd	> 999	> 800	
	3	レャンプー:		L			
	-						

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Lab number: Patient: Hair Head

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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, 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.

# Mercury High

Hair mercury (Hg) is an excellent indiator of exposure to methylmercury from fish. Mercury is toxic to humans and animals. Individuals vary greatly in sensitivity and tolerance to Hg burden.

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, fish, water supplies, some hemorrhoidal preparations, skin lightening agents, instruments (thermometers, electrodes, batteries), and combustion of fossil fuels, Ayurvedic herbs, 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  $\mu$ g/g) than are baseline levels for those without (below 1  $\mu$ g/g).

Confirmatory tests for elevated Hg are measurement of whole blood as an indication of recent/ongoing

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exposure (does not correlate with whole body accumulation) and measurement of urine Hg before and after administration of a dithiol metal binding agent such as DMSA or DMPS (an indication of total body burden).

#### 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 Low

Hair Copper (Cu) levels are usually indicative of body status with two exceptions: (1) addition of exogenous Cu (occasionally found in hair preparations or algaecides in swimming pools/hot tubs), and (2) low hair Cu in Wilson's or Menkes' diseases. In Wilson's disease, Cu transport is defective and Cu accumulates, sometimes to toxic levels, in intestinal mucosa, liver and kidneys. At the same time, it is low in hair and deficient in other peripheral tissues. In Menkes' disease, the activity of Cu dependent enzymes is very low. Cu supplementation is contraindicated in these diseases.

Cu is an essential element that is required for the activity of certain 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.

Symptoms of Cu deficiency include: elevated cholesterol, increased inflammatory responses, anemia, bone and collagen disorders, reproductive failure, and impaired immunity. Possible reasons for a Cu deficiency include: intestinal malabsorption, insufficient dietary intake, molybdenum excess, zinc excess, and chelation therapy. Cu status is adversely affected by excess of antagonistic metals such as mercury, lead, cadmium, and manganese.

Confirmatory tests for Cu deficiency are serum ceruloplasmin to rule out Wilson's disease (ceruloplasmin is deficient in Wilson's disease), a whole blood or packed red blood cell elements analysis, and a functional test for Cu (barring zinc deficiency) is measurement of erythrocytes SOD activity. Erythrocyte SOD activity is subnormal with Cu deficiency.

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# 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.

# 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. Lab number: Patient: Hair Head

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