Assessment of some trace elements and their correlation among themselves and with TSH in Hashimoto's thyroiditis tissue samples

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Abstract

Trace mineral analysis at the solid tissue level can provide more information than blood or urine analysis, revealing the role of minerals in organ-specific illnesses. The percentage of trace elements present in patient tissue samples was calculated using the X-ray fluorescence (XRF) technique. XRF is a rapid and easy approach to determining the presence of elements such as titanium (Ti), iron (Fe), nickel (Ni), cooper (Cu), zinc (Zn), and Cu/Zn at trace levels (less than 1 ppm). Hashimoto's thyroiditis (HT) is a type of autoimmune thyroiditis. Because the thyroid cannot produce enough thyroid hormone, your body cannot function properly. The results showed the concentration of trace elements in ppm as follows: Ti=0.0441±0.02, Fe = 0.04±0.027, Ni = 0.02±0.007, Cu = 0.17±0.036, Zn = 0.11±0.01and Cu/Zn = 1.53±0.229 ppm. The results refer to a significant positive correlation between Fe with Ti, Cu, Zn, and Cu/Zn and thyroid stimulating hormone (TSH), Cu with)Fe, Ni, Zn, and Cu/Zn(, and Ni with)Cu, Zn, and Cu/Zn(while there is a negative correlation between TSH and (Ti, Ni, Cu, Zn, and Cu/Zn) but the results are not significant except for TSH with Cu.

Keywords: *Hashimoto's thyroiditis, trace elements, thyroid gland ,TSH, thyroid tissue.*

Introduction

The thyroid gland is highly perfused, making it a good target for metal buildup and endocrine disturbance. This makes thyroid tissue a valuable public health study target. Thyroid tissue samples are only available after surgery or autopsy; therefore, investigations are limited [1]. Zinc helps cells differentiate, proliferate, repair, and rejuvenate[2]. Growth, endocrine balance, thyroid function, and glucose metabolism are all impacted by zinc's presence. Zinc deficiency decreases thyroid hormone release, which lowers metabolism and the resting metabolic rate [3,4]. Nickel, the 24th most prevalent element on Earth, is essential for human bodily processes. Increased exposure may poison humans. Forest fires, volcanoes, and wind-blown dust emit nickel. Coal combustion and garbage incineration release nickel into the air, while tobacco smoke exposes individuals to nickel [5,6]. There is a positive link between serum Cu levels and free and total thyroxine (T4) in females, as well as total thyroxine and total triiodothyronine (T3) in males, as indicated by the findings of the National Health and Nutrition Examination Survey (NHANES) [7]. Autoimmune thyroid disorders that are associated with Hashimoto's thyroiditis Hypothyroidism can be caused by lymphocyte infiltration into the thyroid gland[8]. Thyroid peroxidase and

thyroglobulin autoantibodies indicate illness. Women outnumber men. Family and twin studies reveal strong inherited sensitivity to the disorder, whose etiology and pathogenesis are unknown. Genes affect disease onset, progression, and severity [9,10].

Methodology:

A total of 27 tissue samples were investigated. All samples were collected after surgery (thyroidectomy) at a hospital. Thyroid samples were collected from patients with Hashimoto's thyroiditis (HT, n = 27). Information on the patients is given in Table 1. Tissue samples, weighing approximately 30 g each, were collected from the patient. They were left in a container of plastic filled with formaldehyde for transportation from the hospital to the laboratory for analysis. The samples were dried in an oven at 70 degrees for about 4 hours and then ground to get a powder of each sample. Approximately 0.5 g of tissue powder was used for analysis. Figure 1 depicts the preparation of tissue samples for testing. X-ray Fluorescence technique: EDX3600B X-ray Fluorescence Spectrometer, all powder tissue samples were tested by XRF to obtain the mineral in low ppm concentration with a limit detection of 0.01-0.99 ppm and precision up to 0.05%. [11,12]

FIG.1: Preparation tissues samples for test

Table (1): Information about patients with thyroid activity by serum test for patients

SC.	Age	Gender	Smoke case	Blood Group	TSH
T1	40	Female	Smoker	NA	5.97
T2	41	Female	Nonsmoker	NA	1.03
T3	38	Female	Nonsmoker	NA	4.33
T4	42	Female	Nonsmoker	NA	2.59
T5	38	Female	Nonsmoker	NA	1.03
T6	48	Female	Smoker	O+	2.59
T7	43	Male	Smoker	O-	5.93
T8	39	Female	Nonsmoker	O+	.77
T9	40	Female	Smoker	AB+	1.77
T10	55	Female	Nonsmoker	O+	3.93
T11	35	Female	Nonsmoker	A+	5.93
T12	30	Female	Nonsmoker	B+	2.21

T13	44	Male	Nonsmoker	AB+	6.93
T14	30	Female	Nonsmoker	O+	4.83
T15	36	Female	Nonsmoker	B+	5.62
T16	43	Female	Smoker	O-	1.03
T17	47	Female	Nonsmoker	AB	3.22
T18	26	Female	Nonsmoker	O+	2.80
T19	37	Female	Smoker	B+	5.93
T20	62	Female	Smoker	A+	3.11
T21	40	Female	Smoker	NA	1.59
T22	18	Male	Nonsmoker	NA	1.80
T23	55	Male	Smoker	A+	6.93
T24	35	Female	Nonsmoker	B+	4.93
T25	45	Female	Nonsmoker	B+	5.20
T26	35	Female	Nonsmoker	AB+	1.77
T27	42	Female	Nonsmoker	NA	2.59

Results

In this study, the results in Table 2 represent the mean, standard deviation, maximum, and minimum trace element concentrations for Hashimoto's thyroiditis patients. The TSH serum was found to be positively correlated with Fe, r = 0.479; the results were statistically significant at the 0.01 level, P = 0.002. TSH has a significant negative correlation with Cu at the level of 0.05, p = 0.027, r = -0.425, and it is also negatively correlated with Ti, Ni, Zn, and Cu/Zn but without statistical significance. Ti was found to be positively correlated with Fe, r = 0.38, and the results were statistically significant at the 0.05 level, p = 0.046. Negatively correlated with Ti were TSH, Ni, Cu, Zn, and Cu/Zn, without any statistical significance. Fe was found to be negatively correlated with Cu, Zn, and Cu/Zn; the results were statistically significant at the 0.01 level for Cu and Cu/Zn and the 0.05 level for zinc; also, the results showed an appositive correlation between Fe and Ni, but the result was not statistically significant. Ni with Cu, Zn, and Cu/Zn exhibited positively significant correlations. Cu with Zn and Cu/Zn exhibited positively significant correlations at the 0.01 level (r = + 0.814 and + 0.881, respectively). Zn and Cu/Zn showed positive correlations at the 0.01 level (r = + 0.490, p = 0.009).

Table (2): Trace elements concentration in ppm

SC.	Ti	Fe	Ni	Cu	Zn	Cu/Zn
T1	0.06	0.05	0.01	0.12	0.1	1.2
T2	0.03	0.02	0.02	0.2	0.11	1.8
T3	0.02	0.05	0.02	0.18	0.11	1.6
T4	0.03	0.02	0.02	0.2	0.12	1.7
T5	0.06	0.02	0.03	0.2	0.12	1.7
T6	0.04	0.02	0.02	0.18	0.11	1.6
T7	0.06	0.04	0.01	0.13	0.1	1.3
T8	0.03	0.02	0.03	0.21	0.13	1.6
T9	0.02	0.01	0.02	0.17	0.11	1.5
T10	0.08	0.06	0.02	0.15	0.11	1.4
T11	0.08	0.07	0.03	0.15	0.11	1.4
T12	0.04	0.03	0.02	0.16	0.1	1.6
T13	0.03	0.04	0.02	0.18	0.11	1.6
T14	0.02	0.14	0.02	0.15	0.11	1.4
T15	0.04	0.01	0.04	0.27	0.13	2.1
T16	0.03	0.04	0.02	0.15	0.11	1.4
T17	0.04	0.03	0.01	0.18	0.1	1.8
T18	0.03	0.04	0.01	0.1	0.09	1.1
T19	0.06	0.06	0.02	0.15	0.1	1.5
T20	0.06	0.03	0.02	0.21	0.12	1.8
T21	0.02	0.05	0.02	0.12	0.1	1.2
T22	0.02	0.02	0.02	0.18	0.1	1.8
T23	0.1	0.06	0.01	0.11	0.09	1.2
T24	0.08	0.09	0.01	0.14	0.1	1.4
T25	0.03	0.05	0.02	0.15	0.1	1.5
T26	0.02	0.02	0.02	0.19	0.11	1.7
T27	0.06	0.05	0.02	0.19	0.13	1.5
Mean± SDs	0.0441±0.02	0.04±0.027	0.02±0.007	0.17±0.036	0.11±0.01	1.53±0.229
MAX	0.1	0.14	0.04	0.27	0.13	2.08
MIN	0.02	0.01	0.01	0.1	0.09	1.11

Table (3): Correlation between trace elements and TSH in tissue samples

		Ti	Fe	Ni	Cu	Zn	Cu/Zn	TSH
Ti	Correlation Coefficient(r-value)	1	.388*	-0.177	-0.197	-0.078	-0.249	-0.044
	Sig. (2-tailed)/ p-value	.	0.046	0.377	0.325	0.699	0.211	0.829
	N	27	27	27	27	27	27	27
Fe	Correlation Coefficient(r-value)	.388*	1	-0.343	-.685**	-.407*	-.693**	.572**
	Sig. (2-tailed)/ p-value	0.046	.	0.08	0	0.035	0	0.002

	N	27	27	27	27	27	27	27
Ni	Correlation Coefficient(r-value)	-0.177	-0.343	1	.635**	.736**	.428*	-0.127
	Sig. (2-tailed)/ p-value	0.377	0.08	.	0	0	0.026	0.528
	N	27	27	27	27	27	27	27
Cu	Correlation Coefficient(r-value)	-0.197	-.685**	.635**	1	.814**	.881**	-0.425*
	Sig. (2-tailed)/ p-value	0.325	0	0	.	0	0	0.027
	N	27	27	27	27	27	27	27
Zn	Correlation Coefficient(r-value)	-0.078	-.407*	.736**	.814**	1	.490**	-0.225
	Sig. (2-tailed)/ p-value	0.699	0.035	0	0	.	0.009	0.259
	N	27	27	27	27	27	27	27
Cu/Zn	Correlation Coefficient(r-value)	-0.249	-.693**	.428*	.881**	.490**	1	-0.376
	Sig. (2-tailed)/ p-value	0.211	0	0.026	0	0.009	.	0.053
	N	27	27	27	27	27	27	27

Conclusions

This study demonstrated the presence of an imbalance of trace elements such as iron, nickel, zinc, and copper among Hashimoto's thyroiditis patients, which highlights the significance of these elements in the upkeep of normal thyroid homeostasis.

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