International Journal of Life Sciences Research (IJLSR)
Vol. 1, Issue 1, pp: (31-36), Month: October-December 2013, Available at: www.researchpublish.com

Evaluation Of Serum Cobalt Concentration And Its Effects On Hyperthyroidism

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Abstract: **In this paper we mention a new finding related to the correlation between serum cobalt concentration (SCC) and hyperthyroidism. For the purpose of research, patients (n=100) suffering from hyperthyroid were randomly selected to form an experimental group. The control group (n=50) was formed while keeping in mind the sex and age of the experimental group; the intent being, that there should be a cross-match between the control group and the patients so that their key characteristics would stay very much similar. We analyzed the blood samples of both groups for thyroxin (T4), thyroid stimulating hormone (TSH) and cobalt concentration in the serum. The results showed a significant difference in the serum cobalt concentration of the experimental group and the control group. The mean serum cobalt concentration in hyperthyroid patients who were at the later stage of disease was much lower as compared to the members of the control group (0.192 ± 0.114 ppm and 0.229 ± 0.089 ppm respectively). This clearly indicates that there is a direct relationship between hyperthyroidism and low concentration of cobalt in the blood stream. This concentration decreases as the length of the disease increases.**

Keywords: **vitamin B12, nuclear medicine, radioimmunoassay, trigger, hyperthyroidism**

I. Introduction

The thyroid gland and hormones play a major role in regulating the metabolism and are central to the human development. Hyperthyroidism results from excess release of thyroid hormones by the thyroid gland. This situation is normally referred as "overactive thyroid". This leads to an increased rate of metabolism in the body by the overproduction of thyroxine (T4) and tri-iodothyronine (T3) hormones.

The literature reveals that disturbance in thyroid hormones not only disturbs the growth and development of the body but also result in imbalance of dynamic equilibrium of various trace elements in biological systems[1],[3] resulting in many ailments[4],[5].

Trace elements are essential for the human body to maintain its normal as well as complex physiological functions related to metabolism. They play an imperative role in several enzyme systems and are used as biomarkers in clinical studies [6], [7].Their deficiencies are often leads to the unceasing diseases [8],[9].

Trace amount of cobalt is a key constituent of vitamin B12 and its deficiency results in fatigue, anemia, impaired nervous system functioning, and can increase the risk of other infectious diseases [10],[12].

Many researchers have tried to investigate the relationship between the hypothyroidism and the serum metal profile of patients [13],[15] but according to our best knowledge no work has been done so for on the serum cobalt concentration.

In this work we have studied T4, TSH and serum cobalt concentration in the blood samples of the experimental and control group. Results showed a relationship between serum cobalt concentration and hyperthyroidism. Hyperthyroidism is normally diagnosed by complete medical history and testing of the patient and sometimes by bone X-rays. This research can open a new frontier for the diagnosis of hyperthyroid where low concentration levels of cobalt in the suspected candidate of hyperthyroid can dictate for further simple confirmatory tests.

II. Materials and methods

Blood samples of the patients suffering from hyperthyroid were collected from the Nuclear Medicine Centre of Mayo Hospital Lahore . The experimental group was formed by selecting 100 patients who had a previous history of hyperthyroid . Age and sex of the patients kept in mind during the formation of the experimental group. 50 healthy volunteers were chosen to form a control group. The control group was selected so that they have a good resemblance in age and sex with the experimental group. A questionnaire was used in order to get data about age, sex and length of disease.

Blood samples of the experimental and control group members were collected in 5 ml sterilized vials . Serum was separated by low speed centrifugation (2000x g) for 5 minutes at room temperature. Serum samples were stored at -20C till further analysis. Serum T_4 was determined by radioimmunoassay (RIA). TSH was determined by IRMA techniques, using commercial kits of Immunotech Inc. (Beckman,Czech Republic). All measurements related to radioactivity, fitting of the standard curve and analysis of samples was carried out using a computerized gamma counter (Cap-RIA 16, CAPINTEC; Inc. USA). Assay reliability was determined by the use of commercially derived control sera of low, medium and high concentrations which were included in every run. All assays were carried out in duplicate.

The serum samples were also analyzed for cobalt concentration by atomic absorption spectrophotometer (Varian AA-240Z) with Hollow cathode lamp and deuterium lamp background corrector. Operational standards were maintained and checked frequently according to recommendations of the manufacturer. To get maximum precision and accuracy each sample was analyzed in triplicate.

All the chemicals used in this study were of analytical grade supplied by the Merck (Darmstadt, Germany). Nitric acid and hydrogen peroxide is used for the wet acid digestion method. Different Standard solutions of cobalt were prepared by dilution of standard stock solution of cobalt (1000 ppm) immediately before their use. Ultra pure water was used throughout the work. Glass and plastic-wares used in this study were washed by soaking them in Nitric acid, rinsed with distilled water and then with ultra pure water.

Data obtained was processed for statistical parameters and results were presented in an understandable form.

III. Results

All the collected blood samples were analyzed for T4, TSH and serum cobalt concentration (SCC). Members of the experimental group were categorized based on the length of disease. First category (n=46) was consisted of the patients who were suffering from the last six months and the second category (n= 34) was for those patients who were suffering through disease since 1 to 5 years. The third category (n=20) was for those patients who had history of the disease longer than 5 years. During this research activity, our main focus was to find out the relationship of cobalt serum concentration and hyperthyroidism. T4 and TSH values were measured to identify the presence of disease.

IV. Discussion

Hyperthyroidism is a type of thyrotoxicosis, a hypermetabolic clinical disorder which occurs when there are elevated serum levels of T3 and T4.Thyroid hormone is important at a cellular level, affecting nearly every type of tissues in the body. Thyroid hormone functions as an organizer of the lick of all of the processes in the body and is critical to the normal function of cells. Surplus thyroid hormone over stimulates metabolism and disturb the effect of the sympathetic nervous system, causing acceleration of various body mechanisms.

Trace elements are the important constituent of the human blood serum and perform various functions including the cofactors for many enzymes. A number of studies are directed towards an attempt to trace any viable relationship between the various trace elements and diseases.

Table 1: Summarized Results for the Control Group (n=50)

	Age	T4(pmol/L)	TSH(mIU/L)	SCC(ppm)
Minimum	20	13.5	0.72	0.123
Maximum	56	21.1	3.29	0.375
Mean	39.81	17.24	1.80	0.229
Median	40	17.9	1.60	0.24
SD	10.74	2.58	0.85	0.089

Table 1 shows the values of T4(pmol/L), TSH(mIU/L) and serum cobalt concentration (ppm) for the control group. Minimum cobalt concentration that was observed in the healthy volunteers of control group was 0.123 ppm while maximum was 0.375 ppm and mean value obtained was 0.229 ppm.

Table 2: Summarized Results for the First Category of Patients (n=46)

	Age	T4(pmol/L)	TSH(mIU/L)	SCC(ppm)
Minimum	19	26.0	0.050	0.144
Maximum	55	71.20	0.060	0.456
Mean	32.45	45.45	0.051	0.304
Median	30	41.70	0.050	0.32
SD	10.04	13.84	0.003	0.114

Table 2 shows resuts for the patients who were suffering since 6 months and SCC ranges from 0.144 to 0.456 ppm with a mean of 0.304. Here it is important to note that the people who were at early stage of disease has higher mean value of cobalt concentration than the normal people. It seems quite difficult to find out a proper answer for this higher concentration.

Table 3: Summarized Results for the Second Category of Patients (n=34)

	Age	T4(pmol/L)	TSH(mIU/L)	SCC(ppm)
Minimum	16	28.90	0.050	0.096
Maximum	50	75.20	0.080	0.40
Mean	30.25	49.52	0.052	0.207
Median	25	46.1	0.05	0.173
SD	11.47	14.07	0.008	0.133

Table 4: Summarized Results for the third Category of Patients (n=20)

	Age	T4(pmol/L)	TSH(mIU/L)	SCC(ppm)
Minimum	16	25.9	0.05	0.048
Maximum	48	72.9	0.08	0.30
Mean	30.66	43.15	0.053	0.192
Median	28	41	0.05	0.24
SD	10.138	16.76	0.008	0.114

Table 3 presents results for the patients who were suffering from the disease since last 1 to 5 years. Serum cobalt concentration has a minimum value of 0.096 ppm while maximum 0.40 ppm with a mean value of 0.207 ppm.
But at this stage it is not difficult to realize that the average serum cobalt concentration has a decreasing trend. It was further confirmed when data of the people who were suffering from more than 5 years was analyzed (Table 4). It was found that SCC ranges from 0.048 to 0.30 ppm with an average value of 0.192 ppm.

V. Graphical comparison of the cobalt concentration in hyperthyroid and normal people

Graphical interpretation of the observed results will give deep insight into the subject matter.

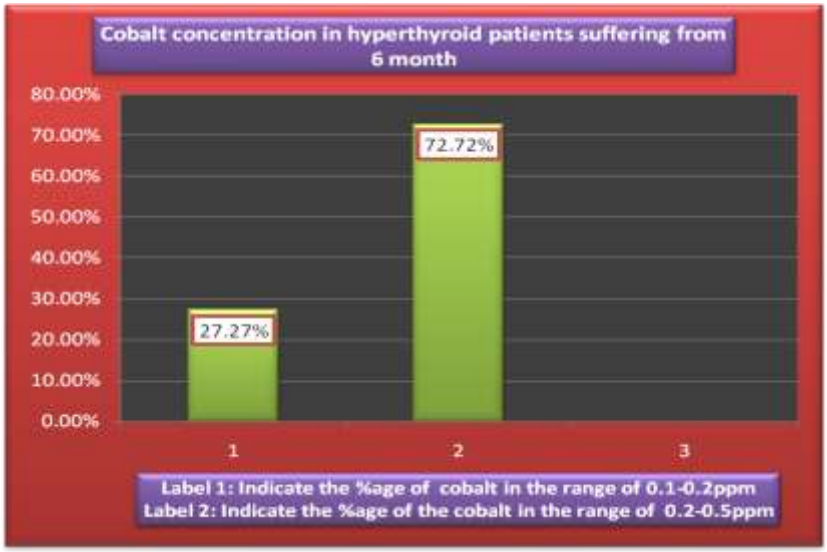

Figure 1: Comparison of the concentrations of the cobalt in hyperthyroid patients suffering from 6 months

Figure 1 indicates the results for the patients who were suffering from the disease since six months. 27.27% patients had SCC in the range of 0.1 to 0.2 ppm while 72.72% had in the range of 0.2 to 0.5 ppm. At this stage of disease, patients had SCC comparable or larger than the control group. At this stage no patients were found with extremely low concentrations of cobalt.

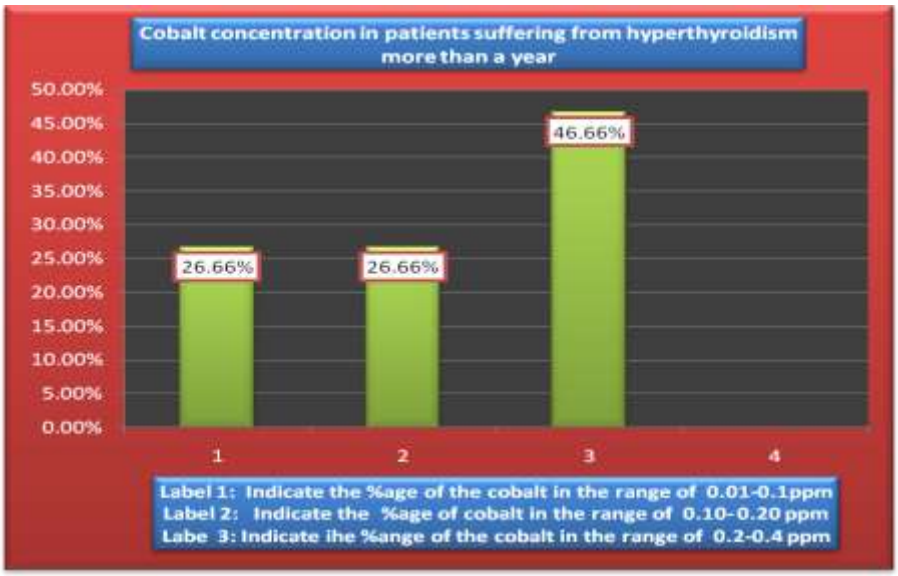

Figure 2: Comparison of the concentrations of the cobalt in hyperthyroid patients suffering from more than a year

Figure 2 shows the results for the patients who were suffering from the disease more than the period of 1 year. It was found that 26.66%, 26.66% and 46.66% of hypothyroid patients had SCC values in the range of 0.01-0.1, 0.1-0.2 and 0.2-0.4 ppm respectively. At this stage extremely low values of SCC has been observed in 26.66 % of the pateints ranging from 0.01 to 0.1 ppm. Such low concentrations of cobalt has not been observed in the patients suffering from the last six months.

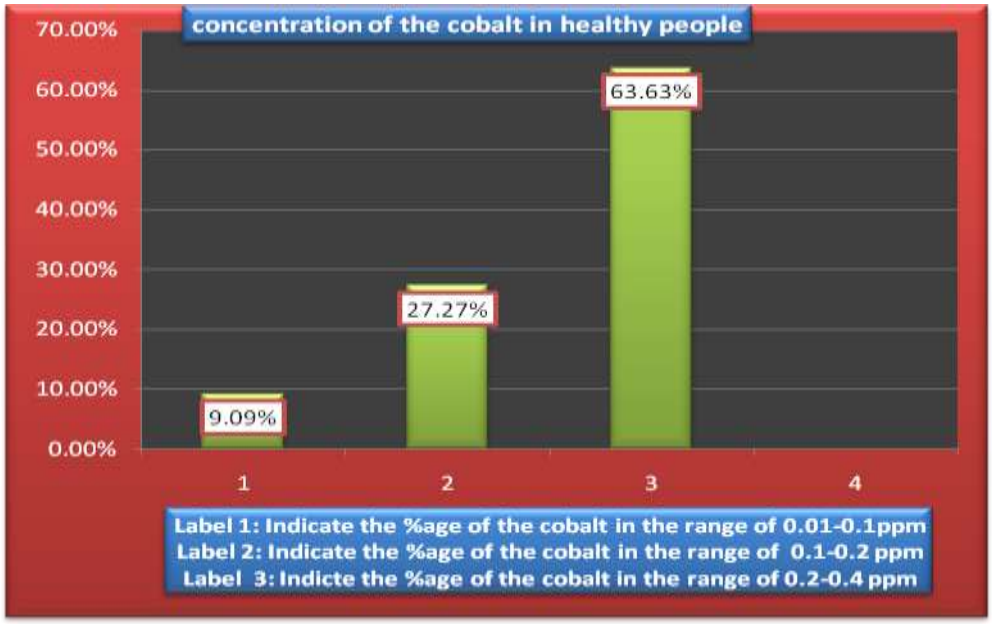

Figure 3: Comparison of the concentrations of the cobalt in the members of control group

Figure 3 shows results for the normal healthy people of control group. 63.63% of the people have SCC values in the range of 0.2 to 0.4 ppm while 27.27% of the people had inbetween 0.1 to 0.2 ppm. Surprisingly, 9.09% of the members of the control group had extremely low values of SCC ranging from 0.01 to 0.1 ppm. It clearly indicates that low concentration of cobalt does not initiate hyperthyroidism but once the disease is started concentration of cobalt goes on decreasing. Concentrations of cobalt were much higher at the initial stages of the disease (Figure 1) compared to later stages of disease (figure 2).

VI. Conclusion

A strong relationship is observed between the concentration of the cobalt and the hyperthyroidism. Although cobalt not trigger the hyperthyroidism but with the passage of time as the suffering time period of the patients of hypothyroidism increased, the concentration of the cobalt in the blood start to decrease. The patient may become macrocytic anemic due to the hyperthyroidism but it needs further study to verify the positive relation of anemia with hyperthyroidism. The normal concentration of the cobalt in the initial time period and lower concentration of the cobalt in the later stages support the following idea:

"The low concentration of cobalt in the blood may not initiate hyperthyroidism but cobalt concentration in the blood decreases as the time duration of the hyperthyroid patient increases."

Acknowledgement

Authors are thankful to Chemistry Department, University of Engineering and Technology for financial support for this project. Authors acknowledge Nuclear Medicine Centre of Mayo Hospital Lahore for providing testing and lab facilities.

References

[1]. Zahang, F., Lru, N., Wang, X., Zhu, l., Chai, Z , Study of trace elements in blood of thyroid disorder subjects before and after 1311 therapy. Biol Trace Elem Res 97(2): 125 – 34 (2004).

[2]. Sibel Ertek, Arrigo FG Cicero, Oya Caglar, Gurbuz Erdogan , Relationship between serum zinc levels, hyroid hormones and thyroid volume following successful iodine supplementation. HORMONES 9(3):263-268 (2010).

[3]. Michael B.Zimmermann and Josef Kohrle, The Impact of Iron and Selenium Deficiencies Iodine and Thyroid Metabolism:Biochemistry and Relevance to Public Health. Thyroid 12(10):867-877(2002).

[4].K.J.Thompson, S.Shoham and J.R.Connor Iron and neurodegenerative disorders. Biol.Trace Element Res 55:155-164 (2001).

[5]. Bellisola G, Bratter P, Cinque G et al, The TSH-dependent variation of the essential elements iodine, selenium and zinc within human thyroid tissues. J Trace Elem Med Biol 12: 177-182 (1998).

[6]. I. Shtangeeva, V. Kulikov Study of chemical element behavior in health and disease by means of neutron activation analysis and multivariate statistics. Nutrition 11:592–594 (1995).

[7]. Qaisara Pasha a, Salman A. Malik a, Munir H. Shah B, Statistical analysis of trace metals in the plasma of cancer patients versus controls. Journal of Hazardous Materials 153: 1215–1221(2008).

[8]. Jong Weon Choi and Soon Ki Kim ,Relationships of Lead, Copper, Zinc, and Cadmium Levels versus Hematopoiesis and Iron Parameters in Healthy Adolescents. Annals of Clinical & Laboratory Science 35(4):428-434 (2005).

[9]. Tasneem Gul Kazi & Hassan Imran Afridi and Naveed Kazi & Mohammad Khan Jamali &Mohammad Bilal Arain & Nussarat Jalbani &Ghulam Abbas Kandhro, Copper, Chromium, Manganese, Iron, Nickel, and Zinc Levels in Biological Samples of Diabetes Mellitus Patients. Biol Trace Elem Res 122:1–18 (2008).

[10]. Bernard, M.A., Nakonezny, P.A., Kashner, T.M, The effect of vitamin B12 deficiency on older veterans and its relationship to health. J. Am Geriatr Soc 46: 1199- 1206 (1998).

[11]. Bottiglieri, T (1996). Folate, vitamin B12, and neuropsychiatric disorders. Nutr Rev 54: 382- 390 (1996)..

[12]. Healton, E.B., Savage, D.G., Brust, J.C., Garrett, T.F Lindenbaum, J Neurological

aspects of cobalamin deficiency. Medicine 70: 229- 244 (1991).

[13].Iham Amir Al juboori, Rafi Al Rawi, Hussein Kadhem A-Hakeim, Estimation of serum copper, manganese, selenium and zinc in Hypothyrodism patients, IUFS journal of Biology 68(2):121-126 (2009).

[14].Gonul simsek,Gulnur Andican, Ethem Unal,Husrev hatemi, Gunnur Yigit and Gulden Candan , Calcium, Magnesium and Zinc status in experimental Hyperthyroidism, Biological trace element Research 57:131-137 (1997).

[15]. Mojgan Sanjari ,A.Gholamhoseinian and A.Nakhaee, Serum zinc levels and goiters in Iranian school children. Journal of trace elements in medicine and Biology 26:42-45 (2012)