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Uric acid profile in apparently healthy people and diabetics

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ABSTRACT

In recent times, hyperuricaemia has been widely diagnosed in individuals due to changes in lifestyle and as a result of disease conditions that lead to elevated levels of uric acid in the blood. Our present work is on determination of the levels of uric acid in healthy individuals and patients with type 2 diabetes mellitus. Prevalence of hyperuricaemia in relation to age, gender and disease condition was monitored. The results indicated that, levels of uric acid are much higher in subjects that have a combined case of hyperuricaemia and type 2 diabetes mellitus.

1. Introduction

Uric acid is the final product of purine nucleotide metabolism in humans. Purines are excreted from the body in the form of uric acid [1,2] (Figure 1). High quantity of these nucleotides is found in many categories of food such as meat. On hydrolysis of purine nucleotides, xanthine oxidase converts xanthine and hypoxanthine to uric acid, which has low solubility in water [3]. The low solubility of uric acid affects its excretion in the urine especially when it is present in large amount in the blood. A number of factors affect the production and level of uric acid in the blood. Some of these factors are lifestyle and eating habits. Inherited disorders of purine nucleotide metabolism often lead to excessive production of uric acid. Intakes of high purine diet as well as impaired excretion of urate are also causes of hyperuricaemia. High activity of xanthine oxidase also results into elevated production of uric acid.

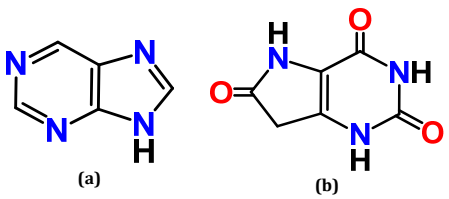

Figure 1. Chemical structure of (a) purine and (b) uric acid.

Some pathological states of the kidney [4,5] and diseases such as type 2 diabetes [6] have some relationships with purine metabolism and excess amounts of uric acid in the blood. There are strong relationships between changes in uric acid concentration and the alterations in metabolism of purines that are related to numerous illnesses and physiological disorders. Consequently, determination of uric acid in the blood is critically important for the diagnosis and for the treatment of diseases such as gout, hyperuricaemia, heavy hepatitis, leukemia, polycythaemia, atherosclerosis, hypothyroidism, diabetes and genetic disorders such as Lesch-Nyhan syndrome. It has also been indicated that excessive high amounts of uric acid in the blood are a marker of renal failure, as well as toxicity [7,8]. Furthermore, conditions that lead to reduced excretion of uric acid from the body system are likely to result into its accumulation and deposition in body tissues [9].

In hyperuricaemia, uric acid is often deposited in tissues of the kidney leading to kidney stones. It may also be deposited in the joints of fingers, hands, and legs in the form of sodium urate in a condition referred to as gouty arthritis or gout [10]. When there are clinical conditions of gout, severe pain and arthritis is felt in the joints. Epidemiological data has suggested that hyperuricaemia is more prevalent in aged male individuals than aged female individuals [11]. Drugs like allupurinol, colchicine and febuxostat are used in the management of hyperuricaemia or gout [12,13].

The purpose of our investigations was to determine the levels of uric acid in human subjects, and to compare the incidence of hyperuricaemia to age, gender and disease conditions such as diabetes.

2. Experimental

2.1. Sampling population

A total of 96 subjects were evaluated in the study. Table 1 shows their distribution in terms of age and/or disease condition.

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Table 1. The sampling population.

	Distribution of the total sampling population (96 individuals)					
	Healthy		Hyperuricaemics		Type 2 diabetics	
	Males	Females	Males	Females	Males	Females
<50 years	6	6	8	8	8	8
>50 years	6	6	8	8	8	8
Control <20 years	4	4	-	-	-	-

Table 2. Results summarizing uric acid values from all the population.

	Average uric acid concentration (μmol/L)			
	Subjects	Healthy	Hyperuricaemics	Type 2 diabetics
Age basis	Control	141.25 ± 6.840[a]	-	-
	<50 years	208.88 ± 10.34[a]	515.00 ± 110.48[a]	1017.25 ± 9.07[a]
	>50 years	329.88 ± 14.14[a]	567.00 ± 157.89[a]	726.50 ± 127.21[a]
Gender/age basis	Males <50 years	208.00 ± 9.84[b]	577.00 ± 2.82[a]	1249.00 ± 11.32[a]
	Males >50 years	359.50 ± 4.66[b]	657.25 ± 17.50[a]	769.50 ± 6.33[a]
	Females <50 years	209.75 ± 12.82[b]	453.00 ± 30.07[a]	392.75 ± 18.44[a]
	Females >50 years	309.25 ± 24.19[b]	472.25 ± 3.89[a]	683.50 ± 33.23[a]

Values = mean ± standard deviation.
[a] Significant at p<0.001.
[b] Not significant at p>0.05.

Statistical analysis such as means, standard deviations and student t-tests were used to compare the data.

2.2. Sample collection uric acid and glucose determination

The blood samples were collected in a 5 mL sterile plastic tubes, and were allowed to clot. The samples were centrifuged using Uriscope laboratory centrifuge (Model SM112, Surgifriend Medicals, England). Clear sera were immediately separated and used to determine uric acid levels by the Uricase method as described by [14]. Colorimetric measurements (related to absorbance) were carried out using Ultrospec Plus 4054 UV/visible spectrophotometer (LKB Model Biochrom, Cambridge, England).

All incubations were performed using Heto water bath (type 11 AT No 496980A HetoHou ALS Gydevang 17-19DK-3450 Adered, Denmark). Serum glucose in each case was determined by the glucose oxidase method [15,16].

3. Results and discussion

The results from the serum uric acid determination are presented in Figure 2 and 3. A summary on the basis of age and gender/age is also presented in Table 1. In order to establish the relationship between age and uric acid levels in the individuals, we have determined serum uric acid concentration in three categories, namely; the control-comprising individuals within the age group of 18-20 years, individuals with ages below 50 years and individuals with ages above 50 years.

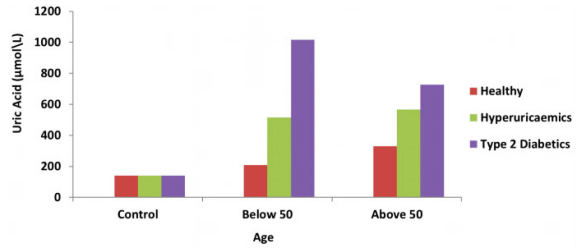

Figure 2. Uric acid levels according to age.

As illustrated in Table 2 and Figure 2, the control had a mean uric acid concentration of 141.25±6.840 μmol\L. For individuals below the age of 50 years, a mean level of 208.88±10.34, 515.00±110.48 and 1017.25±9.07 μmol\L was obtained for apparently healthy, hyperuricaemics and type 2 diabetics respectively. For individuals above the age of 50, the mean uric acid obtained was 329.88±14.14, 567.00±157.89 and 726.50±127.21 μmol\L for apparently healthy, hyperuricaemics and type 2 diabetics, respectively. The reference range (normal concentration) of serum uric acid is 210-420 μmol\L in men and 160-360 μmol\L in females [14]. This implies that serum uric acid values above level this may lead to hyperuricaemia with its many manifestations such as gouty arthritis.

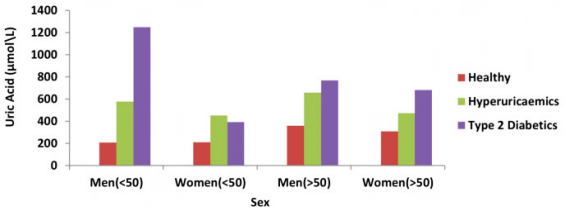

Figure 3. Uric acid levels according to sex.

The control had uric acid level that is within the reference range. This implies that, the control population is free from hyperuricaemia. For individuals below the age of 50 years, the results indicated that healthy individuals had serum uric acid levels within the reference standard range, for both men and women. A close look at Table 2 would reveal that diabetic female subjects with ages above 50 years nearly have average uric acid value that doubled that of females with lower ages suffering from the same disease. This indicates that the subjects are exposed to severe case of hyperuricaemia and its associated manifestations. Some patients in this group complained of joint pain, which is major symptom of arthritis. There is obvious difference between the level of uric acid in hyperuricaemics and healthy people. The highest uric acid level of 1017.25±9.07 μmol\L as shown in Figure 2 was obtained from people suffering from type 2 diabetes mellitus. Higher uric acid levels were obtained from healthy people with age above 50 (329.88±14.14 μmol\L) compared to 208.88±10.34 μmol\L for people below the age of 50. 567.00±157.89 μmol\L, associated with hyperuricaemia.

For type 2 diabetics with ages above 50 years, a uric acid value of 726.50±127.21 μmol\L was obtained. This value is lower than that obtained from people below the age of 50 years. However, it is much higher for individuals with hyperuricaemia but not diabetes. Similarly, the results indicated that uric acid levels are generally higher in individuals with ages above 50 years in comparison to those of a younger age. This is in line with reports that present aged people as being more susceptible to hyperuricaemia compared with younger ones. Persons diagnosed with type 2 diabetes mellitus have shown a very high uric acid levels in their blood

compared to people suffering from diseases such as gout. This indicates that the condition of diabetes may have effects on the oxidation of purine nucleotides. However, the actual relationship between the two is not fully understood due to the complications of metabolic syndrome. The data obtained agrees with the previous reports [17,18].

In order to investigate the relationship between uric acid levels and gender, we have determined serum uric acid in men and women using the same age criteria as in the case of diabetics. As shown in Figure 2, 208.00±9.84, 577.00±2.816, 1249.00±11.32 µmol\L concentrations of uric acid were obtained for men below the age of 50 in healthy, hyperuricaemia and type 2 diabetes status respectively. 209.75±12.82, 453.00±30.07 and 392.75±18.44 µmol\L were obtained for women below the age of 50 in healthy, hyperuricaemia and type 2 diabetes status respectively. Although the results in Figure 3 indicated that men below the age of 50 years had higher uric acid in serum than women, yet individuals in both groups below the age of 50 are exposed to severe cases of hyperuricaemia.

Similarly, as illustrated in Figure 3, the uric acid levels were obtained to be 359.50±4.657, 577.00±2.816 and 769.50±6.327 µmol\L for men above the age of 50 that are healthy, hyperuricaemic and diabetics, respectively. For the females with age above 50, serum concentration of uric acid was found to be 309.25±24.19, 472.25±3.894 and 683.50±33.23 µmol\L for healthy, hyperuricaemics and type 2 diabetics, respectively. This indicated that men either in normal (health) or disease status have slightly higher serum uric acid compared to the women. This situation is as expected [14]. This is also reflected on the age distribution between the two sexes. As suggested by our analysis, slightly higher levels of uric acid are more pronounced in people that have a combined case of hyperuricaemia and type 2 diabetes mellitus (or in type 2 diabetics). The results also demonstrated that serum uric acid level in disease condition is higher in males compared to females. This is consistent and agrees with reports presented by other researchers from previous studies [17,19].

4. Conclusions

It is obvious that trends in uric acid levels that manifest into hyperuricaemia vary amongst individuals relative to age, gender and disease conditions. These variations in the level of hyperuricaemia affect the turnover of purines. Individuals aged above 50 years generally have higher levels of uric acid than their younger ones. They are therefore, more exposed to hyperuricaemia and its consequent manifestations. The levels are higher in diabetics than people suffering from just excessive amounts of uric acid. The result also demonstrated the relative high prevalence of hyperuricaemia on the sampling area.

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