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ALLIED CARE

Hyperuricemia: a Reality in the Indian Obese

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Abstract Hyperuricemia is known to be associated with obesity and metabolic syndrome. The aims of this study were to evaluate the prevalence of hyperuricemia in the Indian obese population and to determine if a correlation exists between hyperuricemia, body mass index, waist circumference and components of metabolic syndrome. This was a retrospective observational study. Four hundred nine obese patients were included. Anthropometric parameters were recorded. Prevalence of type 2 diabetes mellitus (T2DM), hypertension and dyslipidemia were recorded. Uric acid levels were measured in all patients. Hyperuricemia was defined as serum uric acid levels greater than 6 mg/dl. The population studied had a median body mass index (BMI) of 44.14 kg/m^2 (range 28.1–88.2 kg/m^2) and a median age of 41 years (range 18 to 75 years). Overall prevalence of hyperuricemia was 44.6 %. Thirty-four percent in the BMI range of 28–35 kg/m^2 and 47 % of patients with a BMI of >35 kg/m^2 had hyperuricemia. The incidence of hyperuricemia in males was 50 vs 21.7 % in females. Of patients in the hyperuricemia group, 47.3 % had hypertension as compared to 37 % in the normouricemic group. Dyslipidemia was seen in 7.3 % of hyperuricemic patients as compared to 5.8 % of the normouricemic subjects. The prevalence of T2DM was comparable in both the groups. The Indian obese population has a significant high prevalence of hyperuricemia; the incidence of hyperuricemia in male patients was greater than in female patients. Central obesity had no direct link to hyperuricemia. There was no significant correlation between the occurrence of T2DM and dyslipidemia and hyperuricemia. Hypertension was the only comorbidity seen to occur in conjunction with hyperuricemia.

Keywords Hyperuricemia · Gout · BMI · Indian · Obese · Metabolic syndrome · Hypertension

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Introduction

Hyperuricemia is defined as a condition with increased serum uric acid levels eventually leading to gout. Emerging evidence shows that hyperuricemia is prevalent not only in the developed nations but with increasing frequency in the developing countries as well [1]. Few studies however have been reported on the Indian obese population.

Hyperuricemia and its association with obesity and various components of metabolic syndrome have been documented in previous studies [1–6]. The aims of this study were to evaluate the prevalence of hyperuricemia in the Indian obese population and to determine if a correlation existed between hyperuricemia and the degree of obesity—viz body mass index (BMI), abdominal obesity and other components of metabolic syndrome like type 2 diabetes mellitus (T2DM), hypertension and dyslipidemia.

Uric acid or urate is the end product of purine degradation in humans. Uric acid accumulates as the final product of purine catabolism in humans, since we lack the enzyme uricase, which converts uric acid to a water soluble product—allantoin [5, 7, 8]. Approximately two thirds of serum uric acid is produced endogenously and the remaining as a result of

dietary purines [5, 9]. Uric acid is primarily a waste product that is excreted by the urinary tract (70 % by kidneys) and 30 % by the intestines [5, 10].

Decreased excretion by the kidneys is one of the main causes of hyperuricemia. An increased exogenous consumption of proteins as well as an increased endogenous production in the obese individual are other factors that lead to hyperuricemia. The problem becomes clinically significant when serum uric acid levels increase to a level that causes crystalline monosodium urate to be precipitated in the joints [5, 9 10, 11]. Uric acid is usually present as monosodium urate in most biological fluids [11]. When local solubility limits of uric acid are exceeded, monosodium urate crystals get deposited in the joints, kidneys, and soft tissues. Gouty arthritis is caused by intense inflammation secondary to the deposition of monosodium urate crystals in the joints [7, 8].

Gout is a chronic progressive debilitating disease. It has various phases from asymptomatic hyperuricemia, acute gouty arthritis, intercritical gout to chronic gout [8]. Metabolic syndrome itself has been characterised by a clustering of cardiovascular risk factors including abdominal obesity, high blood pressure, T2DM and dyslipidemia [12]; hyperuricemia however has been excluded from this definition.

Methods

This was a retrospective study conducted on 409 obese patients who presented at the Centre of Obesity and Diabetes Surgery clinic during the period between January 2008 and December 2010. Of these patients, 237 were females and 168 were males. Anthropometric parameters such as BMI, waist, hip circumference and waist hip ratios of all the patients were measured. The prevalence of comorbidities such as T2DM, hypertension and dyslipidemia were recorded from history and lab investigations. These data were collected as part of a routine evaluation of patients who had visited the clinic, for obesity management. Consent was taken from all the patients for use of blinded data for clinical and research purposes.

The serum uric acid level of all patients was measured. Hyperuricemia was defined as serum uric acid levels greater than 6 mg/dl. Of all the 409 patients who presented, 15 patients were already on 100 mg allopurinol daily for previously diagnosed hyperuricemia with symptoms of gout

Results

The median BMI was 44.14 kg/m^2 (range 28.1–88.2 kg/m^2) and the median age was 41 years (range 18 to 75 years). The age had no significant bearing on serum uric acid levels.

Of all patients, 44.6 % were hyperuricemic; 34 % of patients in the lower BMI range of 28–35 kg/m^2 (grade I and grade II obesity) and 47 % in the BMI range of more than 35 kg/m^2 had hyperuricemia. We had three patients in the super super obese category (>60 kg/m^2); all of whom had hyperuricemia.

Males had a higher incidence of hyperuricemia as compared to females (50 vs 21.7 %). Of all females, 20.71 % of pre-menopausal women were hyperuricemic compared to 27.94 % of those who were post-menopausal (Table 1). Pearson's correlation coefficient was used to determine the strength of correlation between uric acid, BMI and waist hip ratio (WHR). There was no significant difference between increasing BMI above 28 kg/m^2 and uric acid level, p value=0.0008289, r (420)=0.16, $p<.05$ (Fig. 1). There was no statistical difference between hyperuricemia and WHR p value=0.004045, r (402)=0.14, $p<.05$ (Fig. 2).

Hypertension was the only comorbidity seen to occur in conjunction with hyperuricemia. Those females who had hyperuricemia also had a high percentage of hypertension (Table 2). There was no significance between the occurrence of T2DM, dyslipidemia and hyperuricemia (Table 3).

Discussion

Prevalence of hyperuricemia ranges from 2.5 to 25 % in various ethnic groups. Chen et al. [1] reported a prevalence of 13.10 % in the Chinese population; Cai et al. [12] reported a prevalence of 16.9 % in the Hangzhou population of China. Uaratanawong et al. reported 24.4 % prevalence among the Thai population [13].

Ford and Agatha reported a prevalence of 5 % in the Caucasian population, 25 % in the Chinese and 2.5 % in the Haida Indian population [14]. Ogbera and Azenabor reported a 25 % prevalence in the Nigerian population [6].

All the above studies reported prevalence in the overall population. However the prevalence of hyperuricemia in our study was 44.6 %; our study was conducted on a purely obese population group and that could be a probable reason for a significantly higher percentage of hyperuricemia.

In his study, Wen et al. [15] reported that Asians in general showed equivalent relative mortality risks at lower BMI's than their American counterparts. He further reported

Table 1 Hyperuricemia and gender comparison

	Total	Hyperuricemia	Percentage
Males	168	84	50 %
Females	237	54	21.7 %
Pre-menopausal	169	35	20.71 %
Post-menopausal	68	19	27.94 %

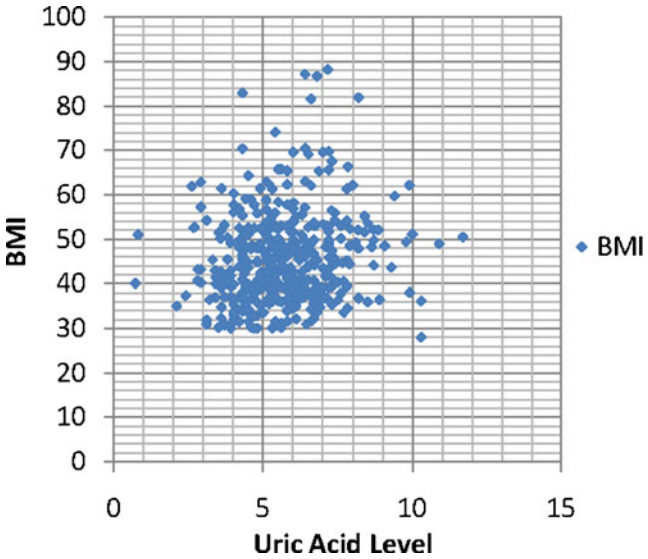

Fig. 1 Correlation between body mass index and uric acid level. *BMI* body mass index

that with every unit increase in BMI, there was an associated 9 % increase in the relative overall mortality risk and that these risks were significantly higher in the Asian population.

Our study showed a high percentage (34 %) of patients in the lower BMI range of 28–35 kg/m^2 with hyperuricemia and those with a BMI of 35 kg/m^2 having a 47 % incidence. Matsuura et al. [16], Bonora et al. [17] and Chen et al. [1] reported that obesity and central body fat distribution were associated with hyperuricemia. Our study however showed no statistically significant correlation in the levels of uric acid and increasing WHR. In relation to comorbidities such as dyslipidemia, T2DM and hypertension, it was noted that there was a statistically relationship only between hyperuricemia and hypertension.

A prospective study conducted by Zhang et al. in a Chinese community showed that increase in uric acid

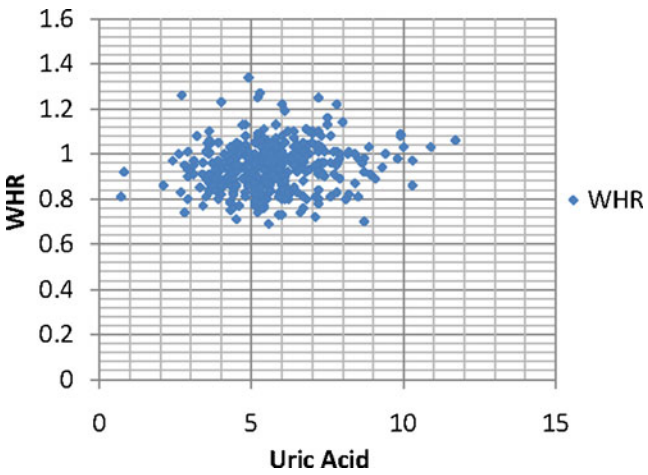

Fig. 2 Correlation between waist hip ratio and uric acid. *WHR* waist hip ratio

Table 2 Gender comparison between hypertension and uric acid

Hypertension		
	Hyperuricemia	Normouricemia
Males	57 %	41 %
Females	53 %	31 %

concentration was associated with an increased risk of incident hypertension and progression of blood pressure [2]. Jawed et al. have also shown a significant increase in serum uric acid in hypertensive patients as compared to normotensive individuals [18].

Forty-seven percent of those patients that had hyperuricemia also presented with hypertension, as compared to 37 % of normouricemic patients. Similar results were seen with other studies [1, 19].

A study conducted by Krishnan et al. revealed that with each unit rise in serum uric acid there is a 9 % increase in the risk of developing hypertension [21]. A possible explanation for this could be that uric acid usually has an antioxidant effect but becomes a strong oxidant in the environment of obesity [2, 10, 20]. Inflammation and oxidative stress induced by obesity may predispose individuals to a higher risk of hypertension [2, 20].

In our study males had a higher percentage of hyperuricemia (50 %) as compared to females (21.7 %).This finding is consistent with other studies [12], 23.7 % in males and 5.3 % in females. We also noticed that in these females who had hyperuricemia, there was a significant increase in hypertension, 53 vs 31 %.

We believe that in lieu of the above findings, serum uric acid testing should be a mandatory pre-op investigation in the obese population and should be repeated at regular intervals post-operatively in order to monitor the resolution of hyperuricemia. In patients presenting for bariatric surgery with hyperuricemia, care should be taken to alter the pre- and post-operative diet accordingly in order to prevent aggravation of hyperuricemia. Pre-operatively, most patients are advised a high protein, low carbohydrate, low fat diet. For hyperuricemic patients, an increased intake of protein should be from vegetarian sources such as soya protein, low fat milk and dairy products and other vegetarian sources such dals and pulses and not from non-vegetarian protein (meat and seafood). Adequate hydration [5] should be maintained in the

Table 3 Distribution of components of metabolic syndrome between hyperuricemia and normouricemic patients

	Hypertension	Type 2 diabetes mellitus	Dyslipidemia
Hyperuricemia	47.3 %	31 %	7.3 %
Normouricemia	37 %	29 %	5.8 %

post-operative period to prevent an exacerbation which can be seen post-bariatric surgery. Allopurinols at least initially should also be prescribed in addition to nutrition therapy. Weight loss will eventually reduce serum uric acid levels; however, patients should be educated and advised to continue with an anti-hyperuricemic diet.

Conclusion

The percentage of hyperuricemia increases significantly in the Indian obese population. However increasing levels of fatness in the obese population or central/visceral obesity do not seem to significantly increase the rates of hyperuricemia; the percent of males was greater than females with hyperuricemia. In females, the menopausal state did not alter rates of hyperuricemia. Hypertension was the only comorbidity seen to occur in conjunction with hyperuricemia. There was no significant relation between the occurrence of T2DM and dyslipidemia and hyperuricemia. Hyperuricemia increases morbidity in the Indian obese population.

Disclosures The authors Carlyne Remedios, Miloni Shah, Aparna G. Bhasker and Muffazal Lakdawala have no conflict of interest in relation to this article.

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