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Sonographic Assessment of Nephrolithiasis in Patients of Type II Diabetes in the 30 to 50 Year Age Group

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Abstract

The risk of kidney stone production may be increased by type II diabetes disorder. Existing cross-sectional data regarding diabetes mellitus as a predisposing factor for nephrolithiasis is limited. Objective: The sonographic assessment of kidney stones in diabetic patients of age, ranging from 30-50 years. Methods: To evaluate the kidney stones in diabetic patients, a descriptive study was conducted comprised of two groups including 200 participants. The questionnaire was used as a primary data collection tool. Their age and gender were evaluated and with the help of ultrasound, the number of stones and their location in kidney of diabetic patients was examined. Results: 66 out of a total of 200 diabetic patients had shown the kidney stones in them. Kidney stones of size 20mm, 22mm causing obstruction were detected in the diabetic patients while sonographic assessment. On the other hand, stones of size 6mm, 14mm, 11mm which were non-obstructive were also observed. The stones of 22mm and 14mm were leading mild to moderate hydronephrosis. 73 stones were detected in patients. Majority of them possessed single stone whereas, two out them contained four stones individually. Conclusion: There is a presence of kidney stones among diabetic patients. According to the present literature, kidney gets affected due to impaired insulin production and accumulation of excessive glucose, but there is a requirement to conduct additional studies to identify the biochemistry behind it as this present study is only concerned with the assessment of stones among the patients who are diabetic.

Keywords: Nephrolithiasis, Type II Diabetes Mellitus, Ultrasound, Sonographic Assessment, Kidney Stones

Introduction

Nephrolithiasis is defined as the formation of kidney stones. The location of these stones can vary, it can be in the kidney or in the lower portion of the urinary tract. These are the most common cause of abdominal pain as well as the blood in the urine. Cystine, urate, oxalate, and calcium are the components that have contributed to the production of kidney stones and are termed as stone-forming components (William C. Shiel Jr., F. 2019). This condition is considered as the most chronic one after hypertension, and it is ancient too (Worcester EM, Coe FL 2008). Kidney stones are more likely to found in men rather than women moreover, to some extent, the types of stones get varied between the sexes. According to the surveys of NIHS regarding the population of

the US, it is shown that the manifestation of kidney stones has been increasing in both genders from the past 30 years (Stamatelou KK, Francis ME, Jones CA, Nyberg Jr LM, Curhan GC 1976–1994, 2003). The factor which can contribute in the development of stone is obesity because a body mass index increases the danger of kidney stones, but main reasons for an increased incidence of kidney stones are vague and unclear (Taylor EN, Stampfer MJ, Curhan 2005). The damage of renal function is also associated with the forms of nephrolithiasis (Worcester EM, Parks JH, Evan AP, et al. 2006). In most of the nations, type II diabetes has reached an endemic percentage irrespective of their economic status (Evan AP, Lingeman JE, Coe FL, et al. 2005). The central pathophysiological phenomenon is insulin resistance. In parallel to the increased metabolic syndrome, the prevalence of nephrolithiasis is also being silently increasing (Evan AP, Lingeman J, Coe F, et al. 2007). Generally, calcium stones are considered as more prevalent in the patients of nephrolithiasis. On the other hand, various studies have revealed the presence of uric acid nephrolithiasis in patients suffering from diabetes (Parks JH, Worcester EM, O'Connor RC, Coe FL 2003).

Limited data exist regarding the relationship between metabolic syndrome, Type II diabetes, and nephrolithiasis. Previous studies have shown that obese and diabetic individuals have increased the pervasiveness of uric acid calculi as compared to non-obese, non-diabetic subjects. The incidence of stone formation is likely to be seen in women because of the greater possibility of hypertension (Gillen DL, Coe FL, Worcester EM 2005). Obesity is considered as a major etiologic factor of insulin resistance. According to the ADA, it is the most usual form of diabetes and it occurs with increasing age, moreover, usually correlated with the insulin resistance (Devuyst O, Pirson Y 2007). Hence this study is carried out to rationalize the role of diabetes in formation of renal stones.

Methods

In this analytical study, 200 patients were included from Department of Radiology Dera Ghazi Khan Medical College and Teaching Hospital, Dera Ghazi Khan. 200 patients of diabetes mellitus age between 30 to 50 years without discrimination of gender were selected by convenient sampling. The kidneys of Diabetic patients with kidney stones were imaged by the ultrasound machine known as TOSHIBA TA machine 311. The patients were included in this study with their consent if they have diabetes, obesity, family history of diabetes and age between 30 to 50 year. Non-corporative, Non-diabetic, patients with anatomic causes and age less than 30 and more than 50 were excluded.

Results

Out of 200 patients, 134 patients suffering from the type II diabetes mellitus without kidney stones and 66 patients suffering from type II diabetes with kidney stones of age ranging 30-50 years were selected. The frequency mentioned in the table 1 is actually the numbers of patients that had participated in the study. The patients were inquired about their status of diabetes and kidney stones. Among the total 200 participants, 67% were those patients who had diabetes but no kidney stones and 33% had diabetes with kidney stones. All the patients who had type II diabetes were above the age of 30 years. By the help of descriptive statistics, the gender of the patients was evaluated. As it was the non-biased gender-based study therefore both the genders were requested to take part in the study

Table 1. Frequency of Diabetic non-stone formers & Diabetic stone formers

Status of Patients	Frequency	Percentage %
Diabetic patients without kidney stones	134	67%
Diabetic patients with kidney stones	66	33%
Total	200	100%

Table 2. Gender distribution of participants

Gender	Frequency	Percentage
Male	128	64%
Female	72	36%
Total	200	100%

Table 2 shows Majority of the individuals who participated in the study were males as compared to the females. 64% (n=128) of the sample population was male whereas 36% (n=72) of the total cases were females.

Table 3 shows the patients were divided into four groups according to their age. The group A referred to the people of 30-35 years, group B contained the people of 35-40 years of age, group C represented the people of 40-45 years of age and the remaining group D included the people of 45-50 years of age.

The following table showing the frequencies and percentage of each group's age.

Table 3. Recorded Age Groups of Participants

Age Groups		
Categories	Frequencies	Percentage
Group A (30-35 years)	41	16.4%
Group B (35-40 years)	57	22.8%
Group C (40-45 years)	50	20.0%
Group D (45-50 years)	102	40.8%

The people of age group 45-50 years had made 40.8% as compared to the people of other age, majority of middle-aged adults had participated in this study. The ultrasound machine was utilized for the sonographic assessment of the number of kidney stones among diabetic patients. Total 73 stones were detected among 66 diabetic kidney stone formers. Many of the patients had shown single stone whereas two patients out of them had shown four stones individually. Both the kidneys (left and right) were examined by the use of the ultrasound machine.

Table 4. A contingency table describing kidney stone detection among diabetic patients

Diabetic status of patients ' sonographic assessment of Kidney stones Crosstabulation

Count		sonographic_assessment of kidney stones		Total
		Detected	Not Detected	
Status of Patients	Diabetic non-kidney stone formers	0	134	134
	Diabetic with kidney stone formers	66	0	66
Total		66	134	200

Table 4 shows the row variables are the diabetic patients with and without kidney stones, whereas, the column variable is the sonographic assessment of stones (2 categories: Detected and non-detected). According to the

table, 66 diabetic patients were detected with kidney stones and 134 diabetic patients were detected without kidney stones. The results of kidney stones detected in patients through the ultrasound machine is as follows:



Figure 5.5 (a) Left kidney shows 20mm obstructing calculus seen in the renal pelvis which is making shadow



Figure 5.5 (b) Right kidney shows 6mm non-obstructing calculus seen in the mid pole and mild echogenic in texture



Figure 5.5 (c) Left kidney show 22mm obstructing calculus seen in renal pelvis leading mild to moderate hydronephrosis

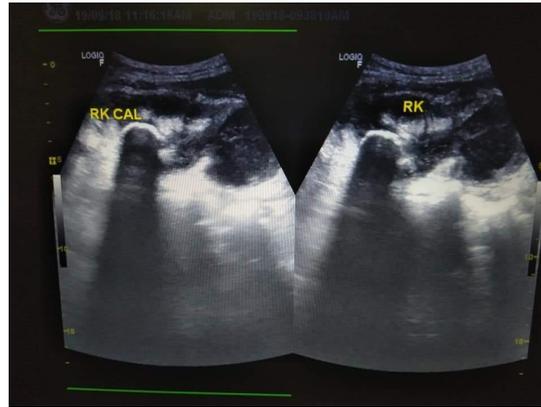


Figure 5.5 (d) Right Kidney shows 14mm calculus seen in superior pole not causing obstruction

Discussion

In the present study, the participants were divided into two categories, such as patients with diabetes and kidney stones and patients with diabetes but non-kidney stone formers. It has been studied that there are various researches have carried out that associate the status of diabetes with body mass index and risk of kidney stone formation and showed that majority of diabetic patients belongs to the category of overweight and obesity whereas the majority of obesity has related to diabetic kidney stone formers. According to recent surveys, investigators have suggested that visceral adiposity is an important factor in developing insulin resistance in type II diabetic patients (Shulman GI 2000).

The cross-sectional study performed by Taylor, Stampfer, and Curhan It was concluded that diabetes mellitus plays a crucial and act as a risk factor for the development of kidney stones (Taylor EN, Stampfer MJ, Curhan GC 2005). Analysis by Daudon and his colleagues and reported that type II diabetes is more in the Uric acid kidney stone formers rather than calcium stones (Daudon M, Jungers P 2004). There is an increased risk of uric stones formation in the individual suffering from type II diabetes besides they are also at risk of containing such stones in general. The findings of the research which was carried out at Mayo Clinic have shown that patients with type II diabetes had produced 40% more stones of uric acid nature as compared to the non-diabetic patients (Robinson LE, van Soeren MH 2004) Regarding diabetes, the report by World Health Organization suggested that 9% of the world's population had diabetes in 2014. Additionally, 5 million deaths per year are caused by diabetes type II mostly from cardiovascular diseases (Taylor EN, Curhan GC 2008) Daudon, Traxer, Consort, Lacour, and Jungers reported that the risk of uric acid stones gets increased by diabetes. The researchers have found that type 2 diabetes mellitus, certain features of metabolic syndrome and the insulin resistance ultimately results in lesser pH of urine. The lower pH of urine is the core factor of uric acid stone production. The hypothesis study was, diabetes mellitus type 2 should contribute to the formation of uric acid stones (Daudon M, Traxer O, Conort P, Lacour B, Jungers P 2006). Daudon and Jungers related the nephrolithiasis and type 2 diabetes precisely in the form of uric acid nephrolithiasis.

According to the authors, patients who used to produce the uric acid stones contain the urine with low pH, which is the key factor of crystallization of uric acid. The formation of such acidic urine usually results from the insulin-resistant state which is the main characteristic of diabetes mellitus (Daudon M, Jungers P 2007) The major risk factor of hypertension and the incidence of diabetes mellitus is nephrolithiasis (Khan SR 2012). According to the results of previous literature, it has concluded that highest body mass index and insulin resistance of diabetic patients may contribute and cause lowering of the urinary pH and enhanced the ammioagenesis with which the uric acid stones can observe in such patients (American Diabetes Association. 2005). The formation of kidney stones gets prevented by altering dietary habits (Zeng G, Mai Z, Xia S, Wang Z, Zhang K, Wang L, Long Y, Ma J, Li Y, Wan SP, Wu W 2017). Kumar and Modi analyzed risk factors for uric acid nephrolithiasis in type II diabetes. The authors concluded that higher body mass index could additionally stress the risk. There is a need to confirm these outcomes by collecting extra data (Kumar KH, Modi KD 2011). The analysis of our present study revealed that 66 diabetic patients had shown the kidney stones while sonographic assessment.

Conclusion

The study shows that Diabetes Mellitus may act as a predisposing factor for the development of kidney stones in patients, or it can further lead to the progression and recurrence of stones specifically in diabetic patients between age 40-50 year. Though, additional studies are needed in order to investigate its contributing risk in the stone formers.

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