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Prevalence of Urolithiasis in Diabetes Mellitus Patients

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ABSTRACT

Background: Urolithiasis and Diabetic Mellitus are common pathologies in the general population, and the lifetime risk of urolithiasis is 12-15% for a man and 5-15% for a woman with up to 50% of the lifetime recurrence ratio. Recent results of urolithiasis prevalence among the diabetic population are varied from 7-21%. We evaluated the prevalence of urolithiasis in the diabetic population in Hasan Sadikin General Hospital, Bandung.
Material and Methods: We performed ultrasound and IVP in diabetic people who have a history of colic or other urinary stone symptoms. The presence of urinary calculi was recorded.
Result: From June 2011 to July 2012, 139 diabetic subjects were participated. Mean age was 49,73 years (CI95= 47,79-51,67), and 78,57% were males. We found 14 cases of urolithiasis in diabetes mellitus subjects (10,07%), and 78,57% of them were males. The 4th-decade group diagnosed urolithiasis was 6 subjects (42,86%), which was the largest case found in the diabetic population.
Conclusions: The prevalence of urolithiasis in the diabetic population in Hasan Sadikin GH was 10.07% in 2012.

Keywords: *urolithiasis, diabetic mellitus*

INTRODUCTION

Urolithiasis is a medical condition characterized by the formation of stones (calculus) in various parts of the urinary tract system, including the kidneys, ureters, bladder, or urethra. The formation of stones in the urinary tract occurs due to the deposition of certain substances which are usually dissolved in urine. Kidney stones are the most common form of urolithiasis. The following is a review of theories regarding urolithiasis from various medical and scientific perspectives. Kidney stone formation, or nephrolithiasis, is a multifactorial process involving the supersaturation of certain substances in the urine and the depletion of inhibitors of stone formation. Kidney stones form when substances that normally dissolve in urine, such as calcium, oxalate, uric acid, or phosphate, reach saturation levels and begin to crystallize. Stages of Stone Formation: a) Nucleation (in the initial stage, small crystals or stone nuclei begin to form. Nucleation can occur through two mechanisms, namely 1) Homogeneous Nucleation: Crystals are formed without any disturbing particles; 2) Heterogeneous Nucleation: Crystals form on the surface of particles in the urine, such as debris particles or dead cells., b) Crystal Growth: After nucleation, these crystals increase in size through the buildup of layers of dissolved minerals in the urine, c) Aggregation: Small crystals can combine to form larger stone structures, d) Stone Retention: Stones or crystals that have formed can get stuck in the urinary tract, causing symptoms or remain in the kidneys.
Factors that play a role in stone formation include Supersaturation: Urine that is too saturated with calcium, oxalate, or uric acid triggers the formation of crystals. Stone Formation Inhibitors: Certain substances in

urine, such as citrate, magnesium, and glycosaminoglycans, function as inhibitors of crystal formation. Deficiency of these substances can facilitate the formation of stones. Urine pH: The acidity or alkalinity of urine greatly influences the formation of certain types of stones. For example, uric acid stones form more easily in acidic urine, while struvite and calcium phosphate stones tend to form in more alkaline urine.

Urinary tract stones (BSK) or urolithiasis and diabetes mellitus (DM) are diseases that are quite common in society. The risk of someone suffering from urinary tract stones in the community is 12-15% in men and 5-15% in women with a recurrence risk of both of them of 50% (1). Several studies have shown an increased risk of urolithiasis in people with diabetes, including studies in the United States (A large cohort study conducted in the US reported that the prevalence of kidney stones in people with diabetes is higher compared to the general population. This risk increases by around 30-50% in type 2 diabetes patients); European studies (studies conducted in Europe also show a link between insulin resistance and the formation of kidney stones, especially uric acid stones. Uncontrolled type 2 diabetes often leads to more acidic urine, increasing the prevalence of uric acid stones); Research in Asia (several studies in Asian countries, including China and Japan, show a similar trend, with a higher prevalence of urolithiasis in people with diabetes compared with the general population. High-purine dietary patterns, as well as poor lifestyle habits, also contribute to This high prevalence. Previous research to determine the prevalence of BSK in DM sufferers varies between 7-21% (2.4). 1,2,3,4), but no one has proven a direct relationship between BSK and DM.

By understanding the prevalence of urolithiasis in diabetes sufferers, doctors, and health workers can take more effective preventive measures, intervene earlier, and reduce serious complications that can arise. This knowledge also helps improve patient's quality of life and reduce the economic burden of health complications. Therefore, a deeper understanding of the prevalence of urolithiasis in diabetes patients is essential in strategies for managing this disease. There has not been much data on the prevalence of BSK in DM sufferers in Indonesia, therefore researchers conducted research to determine the prevalence of BSK in DM sufferers in Indonesia, especially in Bandung.

Research Problem

What is the prevalence of urolithiasis in DM sufferers?

Research purposes

to determine the prevalence of urolithiasis in DM sufferers

Benefits of research

1. **Academic Benefits**
   As prevalence (basic) data for future research
2. **Community Benefits**
   The value of community health indicators is known, so that it can be used as a reference for health service programs for the community.

LITERATURE REVIEW

Urolithiasis is a condition where stones form in the form of crystals that precipitate from urine in the individual's urinary tract [6]. Which includes kidney, ureter, bladder and urethra stones. Urinary tract stones generally contain the elements: calcium oxalate or calcium phosphate, uric acid, magnesium-ammonium-phosphate (MAP), xanthyn, and cystine, silicates and other compounds. Data regarding the content/composition of substances contained in stones is very important for efforts to prevent the possibility of recurrent stones [7]. The prevalence of urolithiasis (stone formation in the urinary tract) in people with diabetes mellitus (DM) tends to increase compared to the general population. Several studies show an association between diabetes mellitus and an increased risk of kidney stone formation or urolithiasis. Several factors that influence the high prevalence of urolithiasis in diabetes mellitus sufferers include: 1) Hyperglycemia: High blood sugar levels can affect electrolyte balance and increase the

excretion of calcium, phosphate and uric acid in the urine, which plays a role in the formation of kidney stones; 2) Obesity and Insulin Resistance: Many people with type 2 diabetes also have obesity and insulin resistance, which are risk factors for kidney stone formation. 3) Low Urine pH: In diabetics, there is often an increase in urine acidity (low pH), which favors the formation of uric acid stones; 4) Dehydration: People with diabetes, especially those with uncontrolled diabetes, often experience dehydration due to polyuria (excessive urination), which causes increased concentrations of stone-forming substances in the urine [8,9,10].

The criteria for diagnosing DM are based on the 2011 Consensus on the Management and Prevention of Type 2 Diabetes Mellitus in Indonesia according to the Indonesian Endocrinology Association (Perkeni), namely, if one of the 4 criteria below is met: a) Classic symptoms of DM (polyuria, polydipsia, polyphagia, and unexplained weight loss) + intermittent plasma glucose ≥200 mg/dL (11.1 mmol). Current plasma glucose is the result of a momentary examination of one day without considering the time of the last meal; b) Classic symptoms of DM + fasting plasma blood glucose ≥126 mg/dL (7.0 mmol). Fasting means that the patient does not get additional calories for at least 8 hours; c)2-hour plasma glucose on oral glucose tolerance test (OGTT) ≥200 mg/dL (11.1 mmol). OGTT, which is carried out according to World Health Organization (WHO) standards, uses a glucose load equivalent to 75 grams of anhydrous glucose dissolved in water.; d) HbA1c (>6.5%) examination by ADA 2011 has been included as one of the criteria for diagnosing DM if carried out in well-standardized laboratory facilities.

How to implement TTGO (WHO, 1994):

- Three days before the examination, the patient continues to eat as usual (with sufficient carbohydrates) and continues to carry out physical activities as usual.
- Fasting for at least 8 hours (starting at night) before the examination, drinking water without sugar is still allowed.
- Check fasting blood glucose levels.
- Given 75 grams of glucose (adults), or 1.75 grams/kgBB (children), dissolved in 250 mL water and drunk within 5 minutes.
- Fast again until blood samples are taken for examination 2 hours after drinking the glucose solution.
- Check blood glucose levels 2 (two) hours after the glucose load.
- During the examination process, the subject being examined remains at rest and does not smoke

MATERIALS & METHODS

Research Design

This research used a descriptive, cross-sectional design.

Place and Time

The research was conducted at the urology and internal medicine clinic at Hasan Sadikin Hospital (RSHS), Bandung, West Java. The research was conducted from June 2011 to July 2012.

Population and Subjects

The target population of the study was patients diagnosed with DM. The accessible population was patients diagnosed with DM who came to the RSHS internal medicine and urology clinic between June 2011 and July 2012. The research subjects were patients diagnosed with DM who came to RSHS and met the inclusion criteria.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. DM sufferers who have been previously diagnosed
2. Age > 20 years

Exclusion Criteria

1. Type I DM sufferers, gestational, and other types.
2. DM sufferers with severe comorbidities

Number of Research Subjects

The number of research subjects required is 139 people. This number is calculated using the formula for categorical descriptive research:

$n = (Z\alpha)\ 2\ PQ/d2$

Where, $\alpha = 5\%$, $Z\alpha = 1.96$

$P = 10\% = 0.1$

$Q = 1\text{-}P$; $Q = 0.9$

$d = 5\%$; $d = 0.05$

$n = (1.96)\ 2 \times 0.1 \times 0.9 / (0.05)\ 2 = 138.29 =$ 139 subjects.

Sampling

The method for selecting subjects was non-random sampling

How Research Works

Patients who had been diagnosed with DM received informed consent to take part in the study. Anamnesis is carried out in the form of a history of stones or red urine, a history of low back pain, a history of previous urinary tract stone surgery, and continued with a physical examination and urinalysis. Further supporting examinations (ultrasonography or BNO-IVP) are carried out according to indications (history of hematuria, recurrent urinary tract infections, passing stones, and impaired kidney function) to confirm the diagnosis. The data is then collected and presented in table form.

Data analysis

Data tabulation was carried out descriptively, data analysis using SPSS 20.0

RESULT

Research result

One hundred thirty-nine subjects aged between 22-82 years (mean 49.73 years; CI95= 47.79-51.67) took part in this study. There were 89 male subjects (64.03%) and 50 female subjects (35.97%). The age group that suffers from DM the most is the 51-60 year age group, 44 people (31.65%) and the least is the 21-30 year age group, 7 people (5.04%).

Of all subjects suffering from DM, 14 people were diagnosed with BSK (10.07%; IK95= 8.06-12.08) of which 11 people were men (78.57%) and 3 people were women (21.43 %). The age group most diagnosed with BSK was the 41-50 year age group with 6 people (42.86%).

Stone analysis of all BSK sufferers who suffered from DM, 12 people had calcium stones (85.71%) and 2 people had uric acid stones (14.29%).

Description of samples of diabetes mellitus patients with urolithiasis based on age, gender, and stone analysis is presented in Tables 1, 2, 3, and 4 below

Table 1. Proportion of urolithiasis in diabetes mellitus sufferers

	n	%	IK 95%
Urolithiasis	14	10.07	8.06-12.08
No Urolithiasis	125	89.93	
Total	139	100.00	

Table 2. Distribution of urolithiasis in DM sufferers according to age

		Urolithiasis		No Urolithiasis		Total	
		n	%	n	%	n	%
Age	**21-30**	0	0.00	7	5.60	7	5.04
	31-40	3	21.43	22	17.60	25	17.99
	41-50	6	42.86	34	27.20	40	28.78
	51-60	1	7.14	43	34.40	44	31.65
	>60	4	28.57	19	15.20	23	16.55

Table 3. Distribution of urolithiasis in DM sufferers according to gender

		Urolithiasis		No Urolithiasis		Total		p value
		n	%	n	%	n	%	
Gender	**Male**	11	78.57	78	62.40	89	64.03	< 0,05
	Female	3	21.43	47	37.60	50	35.97	

Table 4. Distribution of urolithiasis sufferers with DM based on stone analysis

		n	%	p value
Stone Analysis	**Calcium**	12	85.71	< 0,05
	Uric Acid	2	14.29	
	Total	14	100.00	

DISCUSSION

Based on the data above, it can be seen that the proportion (prevalence) of urolithiasis sufferers among DM sufferers at Hasan Sadikin Hospital, Bandung is 10.07%. This figure is no different from that found in the literature and other research. The age group that suffers most from urolithiasis is the 41-50 year age group, this is by the literature which shows that the highest incidence of metabolic diseases such as DM is in the 4th and 5th decade age group.

The gender most commonly found to suffer from urolithiasis is men, which is statistically significantly different from women. This is different from previous research at the Bangetayu Community Health Center where the majority of the Diabetes group, namely prolanis patients suffering from Type 2 DM at Bangetayu Community Health Center, were women, namely 26 people (65%) more than men, 14 people (35%), where in this study It is stated that women are 2.77 times more likely to suffer from diabetes than men. This is because women have more adipose tissue than men, in addition to the reduced production of the hormone estrogen during menopause, women tend to experience abdominal obesity, thereby increasing free fatty acids and triggering insulin resistance (11).

Based on stone analysis, the results showed that the largest percentage was calcium stones compared to uric acid levels. These results are in line with research by Bouha, et al 2021 that the prevalence of urine crystals in diabetes sufferers is 30% lower than in non-diabetes as much as 70%. According to Bouha et al, 2021, age factors influence the formation of urine crystals. The older a person is, the more urine crystals are found due to decreased kidney function, while urine pH has nothing to do with the formation of urine crystals. The results of his research showed that the highest amount of urine crystal formation was at urine pH 5.5, as much as 40%, which is close to the average normal urine pH (pH5.8), and urine crystals were also found at urine pH ≥6 (normal) as much as 30%. Bouha also explained that apart from the age factor, the quality of the water consumed and the patient's geographical area of origin also correlate with the incidence of urine crystals [4].

CONCLUSION

From the research results it can be concluded that the prevalence rate of urinary tract stones at Hasan Sadikin Hospital, Bandung is 10.07%. The majority of sufferers who suffer from urinary tract stones are men and the 4th decade age group, where based on stone analysis it was found that the highest percentage was calcium.

Declaration by Authors

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