Urine pH As An Indicator For Urinary Tract Infections In Patients With Type 2 Diabetes Mellitus

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Abstract:
Aim: *Diabetes Mellitus is a heterogeneous group of diseases, characterized by a state of chronic hyperglycemia. Diabetes Mellitus has a number of long-term effects on the genitourinary system predisposing to Urinary Tract Infections and change in pH. This study focuses on the Urine pH analysis of Diabetic patients and its correlation with urine culture and duration of diabetes to assess if deviation from the normal range is a sensitive indicator of Urinary Tract Infection.*
Methodology: *This is a cross-sectional study carried out in Diabetes special OPD Madha Medical College & Research Institute, Chennai. Sample size was 50 known cases of Type-2 Diabetes, which included 28 females and 22 males age and sex matched.*
Result: *Out of the 50 diabetic subjects, 29 subjects (58%) are diabetic for less than 2 years of which one subject had alkaline pH and two subjects had growth: Escherichia coli and Klebsiella. 21 subjects (42%) are diabetic for more than 2 years of which 8 subjects had alkaline pH. Among the 8 subjects, 6 subjects (75%) had growth. Three Escherichia coli, one Klebsiella, one Pseudomonas and one Streptococcus was isolated.*
Conclusion: *There is increase in Urine pH with increase in duration of Diabetes Mellitus. The usual acidic nature of Urine was found to be disturbed. This study shows that the increase in Urine pH is also a risk factor for the development of UTI in Type 2 Diabetes mellitus patients.*

I. Introduction

Diabetes Mellitus is a heterogeneous group of diseases, characterized by a state of chronic hyperglycemia, resulting from a diversity of etiologies, environmental and genetic, acting jointly.[1]Global prevalence of diabetes is estimated to be 4.4% in 2030 i.e. 366 million.The greatest absolute increase in the number of people with diabetes will be in India. [2]Type 2 Diabetes is characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production, and abnormal fat metabolism. It is much more common than Type 1Diabetes. [3] Diabetes Mellitus has a number of long-term effects on the genitourinary system. These effects predispose to bacterial Urinary Tract Infections(UTIs), which are more common, more severe, and carry worse outcomes in these patients.[4,5]Complicated UTIs are also common and potentially life-threatening conditions. They include emphysematous pyelonephritis, emphysematous pyelitis/cystitis, xanthogranulomatous pyelonephritis, renal /perirenal abscess, and renal papillary necrosis.[4] Various impairments in the immune system, poor metabolic control and incomplete bladder emptying due to autonomic neuropathy are all found to contribute to the enhanced risk of UTI in these patients.[5] In a pH balanced body, urine is acidic due to metabolic activity. The urine pH normally is within the range of 5.5 to 7 with an average of 6.2.[6] This study focuses on the Urine pH analysis of Diabetic patients and its correlation with urine culture and duration of diabetes to assess if deviation from the normal range is a sensitive indicator of UTI.

URINE pH:

Urine, like other body fluids, can be either acidic or alkaline. Acidic substances have a pH of less than 7 and alkaline substances have a higher pH. Urine is slightly acid, with a pH around 6. Excreting acid or alkaline urine helps maintain the body's acid-base balance, the balance between acidity and alkalinity. [11]

The pH of urine is dependent on the time of day, the prandial state, diet, health status, and medications. Urinary pH exhibits a diurnal variation with decreasedpH values at night and in the early morning (most acidic towards midnight) followed by increasing pH values upon awakening. Urine tends to become alkaline immediately after a meal because of a phenomenon known as the alkaline tide and gradually becomes acidic between meals. [12]

Fruits, vegetables, fruit juices, potatoes, and alkali-rich and low phosphorus beverages (red and white wine, mineral soda waters) have a negative acid load. Whereas, grain products, meats, dairy products, fish, and alkali poor and low phosphorus beverages (e.g., pale beers, cocoa) have relatively high acid loads. [13]

Common causes of alkaline urine include respiratory and metabolic alkalosis, prolonged vomiting, urinary tract infectionwith urea-splitting bacteria, and meals. Common causes of acidic urine include respiratory and metabolic acidosis,dietary cranberries, diabetes mellitus, starvation, and severe diarrhea [12]

According to few studies diabetic subjects produce acidic urine irrespective of the disease duration. [14,17,18] Other studies show that the urine pH increased with increase in duration of diabetes. [17,12] The mechanism for the alteration of these urine biochemical indices in the diabetic subjects might be attributed to the development of kidney dysfunction: a known complication of diabetes mellitus in these subjects. [19,20]

II. Materials And Methodology:

This is a cross-sectional study carried out in Diabetes special OPD Madha Medical College & Research Institute, Chennai. Sample size was 50 known cases of Type-2 Diabetes, which included 28 females and 22 males age and sex matched. After obtaining written Informed Consent, midstream urine samples were collected from the study participants. Urine pH test involves only normal urination. There is no discomfort. After collecting a urine sample, it was tested right away using a dipstick made with colour-sensitive pad. Urine pH was analysed and culture sensitivity was carried out to check for growth. The data was tabulated and statistically analysed using SAS 2.0.

III. Results:
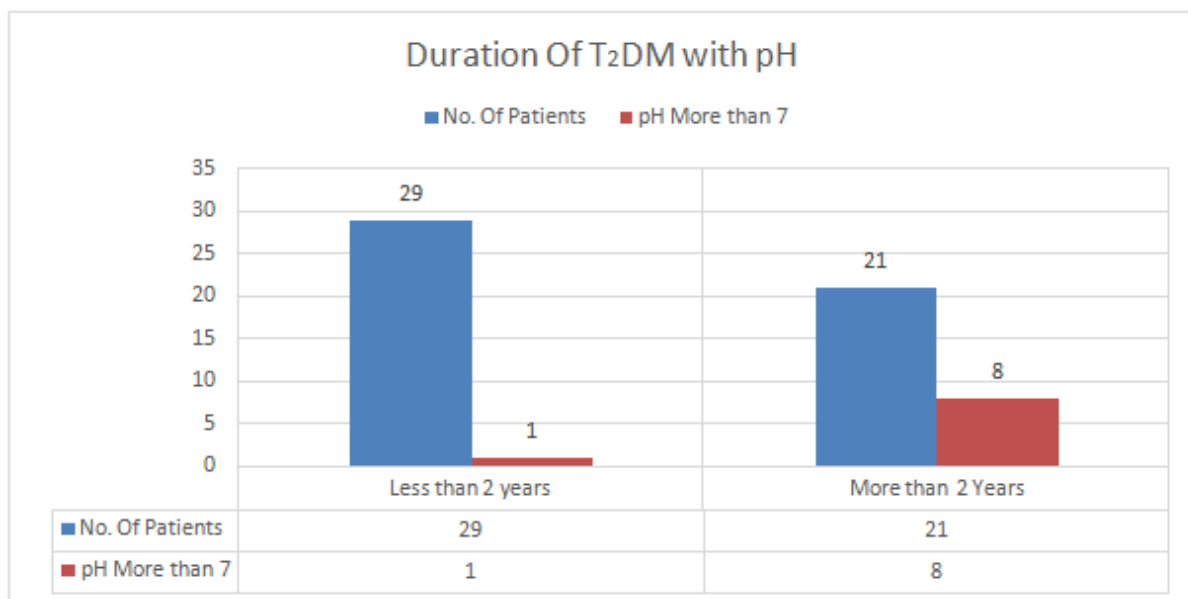
	Less than 2 years	More than 2 Years
No. Of Patients	29	21
pH More than 7	1	8

Out of the 50 diabetic subjects, 29 subjects (58%) are diabetic for less than 2 years of which one subject had alkaline pH and two subjects had growth: Escherichia coli and Klebsiella. 21 subjects (42%) are diabetic for more than 2 years of which 8 subjects had alkaline pH. Among the 8 subjects, 6 subjects (75%) had growth. Three Escherichia coli, one Klebsiella, one Pseudomonas and one Streptococcus was isolated.
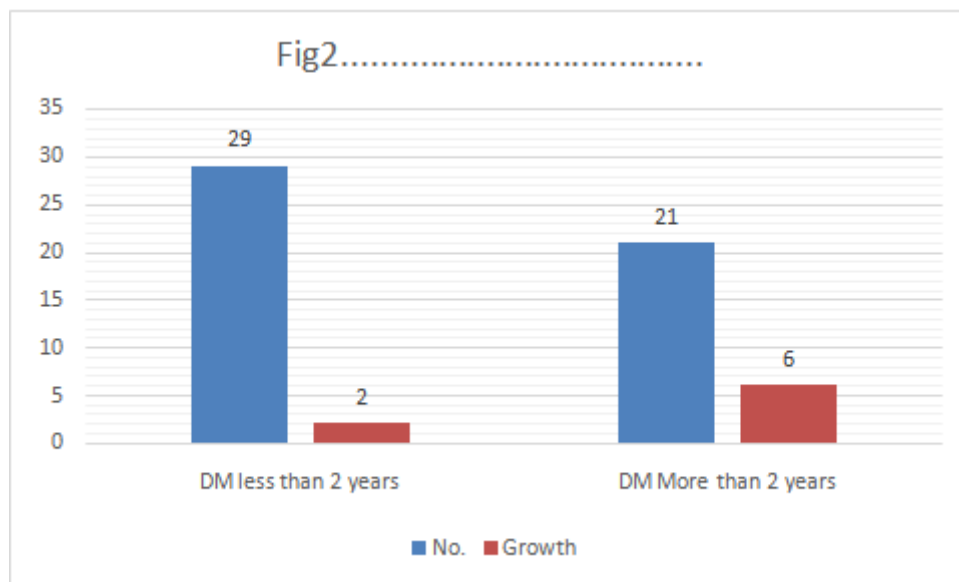
IV. Discussion

Patients with diabetes have an increased risk of Urinary Tract Infection as compared to nondiabetic population. [7]The rate of asymptomatic bacteriuria is three to four times higher in diabetic women. [8] In diabetic patients UTI has a higher chance to run a complicated course which are difficult to treat and recur more often. [9] Urine pH is a simple test that can be performed even in peripheral areas where facilities for detailed tests are non-existent. Some studies revealed that type 2 diabetes is associated with excessively low urine pH, which increases the risk for uric acid nephrolithiasis particularly uric acid stones. The mechanisms underlying unduly acidic urine are patients with type 2 diabetes exhibit greater NAE (exchangeable sodium) and excrete a lower proportion of NAE (exchangeable sodium) as NH_4^+ (ammonium), consumption of acid-rich foods, age, gender, renal function, BMI, increased acid production, increased GI alkali loss, and/or defective urinary buffers such as NH_4^+ excretion.[14,15,16]Whereas some studies show that urine pH increased with increase in duration of diabetes. [12,17]. The mean urine volume, urinary excretion of total protein, potassium and urine pH in the diabetics increased with increase in the duration of the diabetes, while urinary excretion of calcium, urea, creatinine, uric-acid, inorganic-phosphate, urea and creatinine clearances declined with increase in the duration of diabetes. This alteration might be due to the loss of the regulatory role of kidney in urinary calcium excretion as a result of the compromise of kidney function in diabetes mellitus. [17] The alkalinity of urine maybe due to immunosuppressant condition leading to bacterial decomposition of urea to ammonia due to invasion of urea splitting bacteria. Our study reveals that, diabetics with duration of less than 2 years duration had almost normal Ph except for only one individual. But diabetics with more than 2 years duration, out of 21 subjects, 8 subjects had alkaline ph and among the 8 subjects 6 subjects show positive growth in urine culture. Hence, our study shows that with increase in duration of diabetes there is increase in urine pH values i.e. pH goes towards the alkaline side which supports the previous studies. Previous studies also revealed that the susceptibility to UTI increases with longer duration of diabetes. [10] So urine pH should be monitored in diabetic patients to foresee UTI as it is a sensitive indicator.

V. Conclusion

Out of the 50 diabetic subjects, 29 subjects (58%) are diabetic for less than 2 years of which one subject had alkaline pH and two subjects had growth: Escherichia coli and Klebsiella. 21 subjects (42%) are diabetic for more than 2 years of which 8 subjects had alkaline pH. Among the 8 subjects 6 (75%) had growth. Three Escherichia coli, one Klebsiella, one Pseudomonas and one Streptococcus was isolated.

There is increase in Urine pH with increase in duration of Diabetes Mellitus. The usual acidic nature of Urine was found to be disturbed. This study shows that the increase in Urine pH is also a risk factor for the development of UTI in Type 2 Diabetes mellitus patients.

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