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PREDICTIVE VALUE OF URINE PH AND DURATION OF DISEASE FOR URINARY TRACT INFECTIONS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

Pathology

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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 and attempts to generate a predictive estimate model for the same.

Methodology: This is a cross-sectional study carried out in Diabetes special OPD Madha Medical College & Research Institute, Chennai. Sample size was 64 known cases of Type-2 Diabetes. Data was collected, and an ordinal logistic regression model was developed.

Result: Out of the 64 diabetic patients, 31 patients were diabetic for less than 4 years whereas 33 patients were diabetic for more than 4 years. There was a distinct increasing trend towards alkaline pH as duration of diabetes increased. Patients with higher urinary pH and long duration diabetes were up to times more likely to have urinary infection.

Conclusion: Not only there is increase in Urine pH with increase in duration of Diabetes Mellitus but patients with Increasingly higher pH and longer duration of DM have up to 11 times more risk of UTI. Thus, monitoring and treating high urinary pH is important for these patients.

KEYWORDS

I. Introduction

Diabetes Mellitus is a heterogeneous group of metabolic disorders, characterized by, most notably, a state of chronic hyperglycemia, resulting from interplay and consortium of myriad etiologies, environmental, immunological and genetic.[1]It is estimated that by 2030, globally affected population would be 4.4% or 366 million, of which the greatest number of new patients will be from India.[2] Though the classification of the disease has undergone many revisions, the two classical variants are Type I and Type II the latter being commoner and characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production, and abnormal fat metabolism.[3] Diabetes Mellitus, though primarily a metabolic disorder has widespread complications including angiopathic, retinopathic and nephropathic. It also predisposes to infections and Urinary Tract Infections(UTIs) being a common entity among these. UTI may be more severe, carry worse outcomes and is prone for complications in these patients including potentially life-threatening ones like emphysematous pyelonephritis/ pyelitis/ cystitis, xanthogranulomatous pyelonephritis, renal/ perirenal abscess and renal papillary necrosis.[4,5] Higher risk of UTI in these patients is multi-factorial and putative causal factors include impaired immune system, poor metabolic response to infection and incomplete bladder emptying due to autonomic neuropathy.[5]

Under normal homeostatic conditions, urine is acidic with pH ranging from 5.5 to 7 with an average of 6.2.[6] Derangement of urinary pH in patients of diabetes has been a matter of debate ,with some studies showing maintenance of acidic pH whilst others demonstrating an ,increase in pH with the duration of disease.[7,8,9,10] The mechanism for the alteration of these urine biochemical indices in the diabetic patients might be attributed to the development of kidney dysfunction: a known complication of diabetes mellitus in these patients.[11,12] An initial study done at this institution showed that there was a trend towards increasing urine pH in diabetics as the duration of disease increased. This is also associated with increased likelihood of urinary infection.[13] It was felt that this behooved further studies in to the interplay of diabetic duration, urine pH and chances of infection and whether any of these factors had predictive relation to each other.

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 64 known cases of Type-2 Diabetes, which included 38 females

and 35 males age and sex matched. The duration of disease was noted for each patient and was divided into two groups – less than 4 years and more than 4 years. After obtaining written Informed Consent, midstream urine samples were collected from the study participants. After collecting a urine sample, it was tested right away using a dipstick made with colour-sensitive pad. Further culture & sensitivity was carried out to check for microbial growth. The data was tabulated and statistically analysed using SPSS 23.

An ordinal logistic regression model was generated based on PLUM methodology. Pearson goodness-of-fit was estimated and found satisfactory. Parametric estimates were generated and interpreted for predictive values.

III. Results:

A total of 64 patients of type II DM were analysed. Of these 34 were females and 30 were males. Out of the 64 diabetic patients, 33 were diabetic for less than 4 years. In total 11 patients had positive culture growth indicative of urinary infection. Urine pH in patients with diabetes of more that 4yr duration showed an almost bimodal peak with distinct trend towards higher pH, whereas that in diabetics of less than 4yr duration showed a fusiform distribution. [Fig. 1] The ordinal logistic regression model showed the Pearson goodness-of-fit value of to be 78.3%. Parametric estimates showed that –

1. Infection was more common in patients with increasing duration of diabetes. In fact, in our study, patients with diabetes of less than 4yr duration had 0.522 times the risk of culture positive UTI in comparison to those with diabetes of more than 4yr duration. However, this increasing trend was not statistically significant.

2. Infection was also more common in patients with higher urinary pH. For each 0.1 unit rise in urinary pH the chances of infection were 1.33 times more. Thus, each 0.1 rise in urinary pH increase chances of culture positive UTI by 33%. This difference was statistically significant. (p-value <0.05)

3. The conjugation of increased urinary pH and diabetic duration of more than 4yrs was highly significant. The patients in our study who were having a diabetes of more than 4yr duration, has 11 times more chances of culture positive UTI than other patients. Thus, we see that while the duration of diabetes itself does not have significant effect on chances of UTI, if facilitates the chances in presence of high urinary pH manifolds.
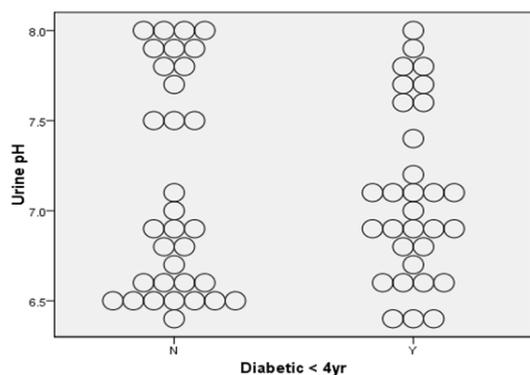
Figure 1

IV. Discussion

Urine, among other functions, helps maintain the body's acid-base balance.[14] In normal homeostatic conditions, urine is slightly acid, with a pH around 6. However, the pH of urine is dependent on the time of day, diet, starvation status, and medications. There's a diurnal variation with decreased pH values at night and in the early morning (most acidic towards midnight) followed by increasing pH values upon awakening. Also, immediate post-prandial urine is alkaline, a phenomenon known as the alkaline tide and gradually becomes acidic between meals.[7]

Common pathological causes of alkaline urine include respiratory and metabolic alkalosis, prolonged vomiting and urinary tract infection with urea-splitting bacteria. Common pathological causes of acidic urine include respiratory and metabolic acidosis, starvation and severe diarrhea.[7]

Patients with diabetes have an increased risk of Urinary Tract Infection as compared to nondiabetic population with the rates being as high as three to four times in diabetic women.[15,16] In diabetic patients UTI has a higher chance to complicate, being difficult to treat and recurring oftener.[17]

Urine pH is a simple test that can be performed even in peripheral areas where facilities for detailed tests are not extant. There have been conflicting reports about pH of urine in diabetics, with multiple studies supporting both acidity and alkalinity. The mechanisms underlying unduly acidic urine are purported to be consumption of acid-rich foods, increased ketoacid production, increased GI alkali loss, and/or defective urinary buffers such as NH_4 excretion.[8,18,19] On the contrary, some studies show that urine pH increased with increase in duration of diabetes.[7,9] 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 initial study revealed that, diabetics with duration of less than 2 years duration had almost normal pH but diabetics with more than 2 years duration had increasingly alkaline trend and positive growth in urine culture. Present study shows that not only the pH has increasingly alkaline trend, but that urinary pH in conjugation with diabetic duration increases the risk of UTI manifold. It must be borne in mind that urinary pH is one corrigible factor in the whole gamut of interplaying factors and thus offers a feasible avenue for intervention to prevent UTI in diabetic patients.

V. Conclusion

The urinary pH in conjugation with duration of diabetes has significantly high risk of culture positive UTI, to the tune of patients being susceptible up to times more. Thus monitoring and correction of urinary pH provides an avenue of prevention of and intervention in culture positive UTI in diabetics of long duration.

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