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CORRELATION BETWEEN URINARY pH AND CYSTOMETRIC PARAMTERS

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ABSTRACT:

OBJECTIVES: *To evaluate the association between urinary pH and cystometric parameters*

METHODOLOGY: *102 patients were included and divided into 3 groups, based on urinary pH. Group 1 included patients with acidic urine, ph less than 6. Group 2 included patients with normal pH of urine (more than 6 and less than 7) and Group 3 included patients having alkaline urine, pH more than 7 and less than 8. The statistical analysis was done on Statistical package of Social Sciences (SPSS) and p-value <0.05 was taken as significant.*

RESULTS: *The urinary volume during the initial morning desire to micturate was greater in patients in group II (p = 0.024) as compared to the patients in group III (0.015). The volume of urine during the initial desire to urinate was significantly greater in patients of group I as compared to urinary volumes of the group III patients. (p = 0.006). When urinary volumes of group I and group II patients were compared, no statistically significant difference was observed (p > 0.05).*

CONCLUSIONS: *The current study concludes that significant association exists between urinary pH and cystometric parameters including residual urine volume during the period of initial desire to micturate and initial urgency of urine.*

KEYWORDS: *Cystometry, Micturation, Incontinence, pH, Urinary tract infection*

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INTRODUCTION:

The normal pH of the urine is about 6 with a physiological range of 4.6 to 8 (1). The pH of the Urine plays an important role in the formation of harmful renal stones. Increased pH, as seen in urinary tract infections, results in the formation of calcium and phosphate crystals which eventually precipitates in the form of stones while decreased pH, caused by uncontrolled diabetes, gout or various acidic drugs, leads to renal stone formation which are rich in uric acid and cysteine (2-4). Of all the patients visiting the urology outpatient departments, Lower urinary tract infections (LUTS) are present in significant number of patients. Several etiological factors are held responsible for lower urinary tract infections which include benign prostatic hyperplasia, urethral diseases, urinary tract infections and hyperactive bladder (5). Urine detailed report (UDR) is an essential investigation to discover cystitis, one of the most common causes of LUTS. However, more advanced diagnostic tests for LUTS includes tests based on Urodynamic parameters. Urodynamics is an essential test for assessing lower urinary tract functions by testing free flow rate measuring post-void residual volume. Cystometry in true sense simultaneously measures urinary bladder and abdominal pressure along with flow rate (6). The correlation between urinary pH and the presence of LUTS has already been investigated and established by various studies (7,8). The objective of this study was to explore the presence of any such correlation between urinary pH and urodynamic parameters based on cystometry.

MATERIAL AND METHODS:

A case control study was designed in which the hospital records of LUTS patients were reviewed who were seen in urology department in 2017-2018. The study included 140 patients who went through both the cystometry and UDR. The exclusion criteria of the study included the following: patients below 18 years of age, patients with prostatic nodules or prostatic hypertrophy confirmed after digital rectal examination, urethral strictures, urinary bladder stones, neurological dysfunctions, previous history of prostatic surgery, bladder or prostatic tumors, pregnant patients and patients with urinary tract infections. 102 patients were finally enlisted and were divided into 3 groups. The grouping of patients was based on urinary pH. Group 1 included patients with acidic urine, ph less than 6. Group 2 included patients with normal pH of urine (more than 6 and less than 7) and Group 3 included patients having alkaline urine, pH more than 7 and less than 8.

At the time of filling cystometry phase, the urinary volumes in the bladder were determined at the time of initial morning desire to micturate, at the initial morning time of urinary urgency and during the time of first incontinence of urine if otherwise present. Such urinary volumes were measured in the current study. Data analysis was performed on Statistical Package of Social Sciences (SPSS) version 22.0 and p-value of less than or equal to 0.05 was taken as statistically significant.

RESULTS:

The results of the present study showed that among the 102 patients, 30 patients were revealed in group 1 with acidic urine, 43 patients were in group 2 which was normal urinary pH group and 29 patients were in group 3 alkaline urinary pH group. There was no any significant difference between the groups in terms of cystometric parameter ($p > 0.05$). The groups were compared in relation to volumes of urine at the instance of initial desire to urinate and initial urinary urgency. It revealed that the urinary volumes of former conditions were greater in patients in 2nd group ($p = 0.024$) as compared to the patients in group 3 (0.015). The volume of urine during the initial desire to urinate was significantly greater in patients of group 1 as compared to urinary volumes of the group 3 patients. ($p = 0.006$). When urinary volumes of group 1 and group 2 patients were compared, no statistically significant difference was observed ($p > 0.05$). Table

Table.1 Cystometric values of patients in various groups.

Parameters	Group 1 (acidic pH) (n=30)	Group 2 (normal pH) (n=43)	Group 3 (alkaline pH) (n=29)
Age (years)	60.78 ±18.89	55.54 ±16.98	58.76 ±16.45
Male	11	13	12
Female	19	30	17
Urinary pH	4.67 ±0.29	5.78 ±0.45	6.21 ±0.58
Volume during the period of initial desire to micturate (ml)	148.46 ±68.34	149.28 ±82.50	90.68 ±51.47
Volume during the period of initial urinary urgency (ml)	178.23 ±76.90	201.56 ±67.82	143.29 ±84.39
Volume during the period of initial increased urinary urgency (ml)	263.78 ±50.43	323.71 ±127.43	326.64 ±49.32
Maximum capacity	311.65 ±56.73	350.29 ±149.38	261.32 ±141.67
Volume during the time of initial urinary incontinence (ml)	135.54 ±56.98	204.32 ±152.15	91.20 ±32.41

DISCUSSION:

The urinary bladder is lined by transitional epithelium also known as urothelium, which comprise of unmyelinated type C fibers that are frequently present in the detrusor muscle close to the urothelial cells (9,10). Such fibers remain inactive but when they are subjected to low temperature or chemical irritation, the may lead to LUTS (11). The transient receptor potential cation channels (TRPV1) and acid sensing ion channel (ASIC) are acidic receptors situated on the terminal of C fibers. These receptors are excited by Hydrogen ions which in turn lead to feeling of acidic urine. (12-14) Therefore, it is proposed that lowering the LUTS symptoms require alkaline urinary pH.

In a research study conducted by Demirbas et al, the relationship was observed between acidic urinary pH and overactive urinary bladder through clinical signs and symptoms and questionnaire data while no any urodynamic parameter was assessed (8). In the present study, however, cystometry was applied as a vital diagnostic test to interpret the association between LUTS and urinary pH.

Brumfitt et al observed in a research study that the symptoms of increased urinary frequency, difficulty in micturition and urinary urgency due to urinary tract infections did not improve even after changing urinary pH or making alkaline urine (15). Acidic pH of urine is observed in patients having gout, diabetes, metabolic syndrome and hyperuricemia with LUTS being more sever in metabolic syndrome. (3,4,16). Ueda et al observed that the patients with hypersensitive bladder undergoing citrate therapy resulted in alkaline urinary pH and that resulted in symptoms relief of pain and sleep issues (17). Christopher et al observed that patients having complaints of pain were not relieved of their symptoms after alkalization of urine, hence the association between urinary pH and pain was found to be negative (18). Demirbas et al conducted a case control study in which 329 patients with known case of overactive bladder and normal 201 controls were compared in terms of urinary pH. The value of urinary pH was found to be more in acidic nature in patients of case group and symptoms of overactive bladder were minimized after urinary alkalization. (8)

Based on the findings of above-mentioned studies, it is proposed that the acidic urine aggravates the symptoms of LUTS while on the contrary, alkalization of urine improves the symptoms. Meanwhile, the current study is somewhat different from the other studies as the association between the cystometric parameters and urinary pH is evaluated. The results of the present study revealed that bladder volumes in patients of normal group and acidic urine group were comparatively greater at the time of initial desire to micturate as compared to the alkaline group patients. Likewise, the bladder volume at the time of initial urinary urgency was observed as greater in the normal group patients as compared to the alkaline group patients.

Most urinary crystals are made up of ions present in the urine which crystalize under the influence of urinary pH (19).

Alkaline urinary pH favors the formation of crystals composed of calcium phosphate, calcium carbonate, triple phosphate, amorphous phosphate and crystals

of calcium carbonate (20). One of the possible causes of having the first desire to void and first urinary urgency at comparatively lower volumes in patients with alkaline urine can be the irritation of the urothelial C-fibres present in the bladder by crystals present in the urine.

In urinary tract infections, the causative bacteria decompose urea which leads to alkalinization of urine resulting in damage to urothelium (21). Consumption of certain citrus fruits like limes, oranges and lemons render the urine alkaline (22). These fruits contain increased amounts of vitamin C, which increases the chances of LUTS if ingested in high doses specially in the form of Multivitamins. Formation of stone is accelerated by the presence of oxalate, which is the metabolic end product of vitamin C. Oxalate has alkaline nature. The alkaline urine promotes irritability to the type C fibres of the bladder. Such alkalinization is attributed by increased intake of citrus foods or desire to urinate more often and frequently secondary to urinary tract infections.

The main constraint of the present study was that no any questionnaire was utilized to establish the association between the urinary pH levels and LUTS. The study design was retrospective.

CONCLUSION:

The conclusion of the present study was that no any significant difference was present among the groups between cystometric paramters and urinary ph. However, the pairwise comparison of groups indicated significant association between cystometric parameters and urinary ph and the cystometric parameters during the initial desire to micturate and initial urinary urgency. Further research studies are needed with increased number of patients along with data collection through questionnaire. Urinary ph levels are liable to diet induced changes which can also be changed with the help of several drugs, hence decreasing the incidence of LUTS

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