GREEN PUBLICATION

International Journal For Research In Biology & Pharmacy

ISSN: 2208-2093

Volume 06 Issue 04 2020
Available on-line at http://ijrbp.com/index.php/bp/issue/view/294

DOI:https://doi.org/10.53555/bp.v6i4.1323

Received: 15-September-2020 Accepted: 23-November-2020

Relation of urinary pH and specific gravity with Urolithiasis, in Jalal Abad, Afghanistan.

Teaching Asistant.Dr.Toryalai Ishaas,

Neurophsycotry Department, Nangarhar Medical faculty

Associate.prof.Dr.M.Azim Azimee

Teaching Asistant.Dr.Abdul Ghafar sherzad

MD.Biochemistry &Microbiology Department, Nangarhar Medical Faculty.

Abstract

Renal stone disease is, also known as Urolithiasis the most frequent recurrent urological problem-having worldwide distribution. Globally, urolithiasis is the third most common urological disease affecting both males and females. In developed countries, up to 12% of men and 7% of women will suffer from kidney stones in their life time, and the prevalence appears to be increasing.

This retrospective descriptive study was conducted to determine the effects of urine pH and specific gravity in the formation of urinary stones among ultrasound confirmed Urolithiasis patients who reported to the Departments of Radiology and Biochemistry –Microbiology of Nangarhar Medical University Teaching hospital. Jalalabad, Afghanistan. Data on patient's age, gender, seasonality, anatomical sites of the stone, biochemical parameters such as urine color, deposit, pH, specific gravity, Albumen, Glucose, Pus cells, Red Blood Cells (RBCs) and crystals were obtained from case records. Nonparametric Kruskal-Wallis Test was used to find mean of specific gravity and pH changed to anatomical location of stone and different seasons. Nonparametric Kruskal-Wallis Test showed that there was no statistically significant difference in urine pH and specific gravity in patients with stones in different anatomical sites.

On testing the correlation between pH and specific gravity using spearman's correlation test showed that there was no statistically significant correlation between pH and specific gravity in urine. The analysis of the effect of seasonality on specific gravity, showed that specific gravity during the summer season was comparatively high compared to that in winter. The difference observed was not statistically significant. With regard to pH, during winter the mean pH was high when compared to that in summer. The difference observed was not statistically significant. Comparing specific gravity and pH, the highest mean specific gravity was observed in summer andthe highest mean pH in winter.

On comparing the mean specific gravity in crystalluric and non crystalluric patients, an increasing trend was observed from urine with crystalluria. On comparing the mean pH with crystalluria a negative trend was observed, an increased pH for urine without crystals and a decreased pH for urine with crystals urine.

Key Words: Urine pH, specific gravity, urolithiasis, Anatomical site, Seasonal variation.

INTRODUCTION

Renal stone disease is, also known as Urolithiasis the most frequent recurrent urological problem-having worldwide distribution [1]In developed countries, up to 12% of men and 7% of women will suffer from kidney stones in their life time, and the prevalence appears to be increasing [2].The prevalence of renal stone disorder is increasing in the United States as well as in other countries [3–5], paralleling the rising rate of obesity in many nations [6–8].This finding has led some authors to demonstrate whether obesity has a role in the development of Renal stone [9–11]. The prevalence and incidence of stone disease have been informed to be associated with body weight and body mass index (BMI) [11]. Though, these epidemiologic studies did not differentiate between the different types of kidney stones, assess the biochemical data, or reflect underlying biochemical mechanisms. Recent studies have shown that patients with recurrent uric acid renal stone display metabolic and clinical features representative of the metabolic syndrome [13, 14]. Furthermore, a recent study showed that patients with renal stones who suffer from type 2 diabetes mellitus have a higher prevalence of uric acid renal stone than in a general population of patients with renal stones [16].

A low urinary pH (<5.5, the pKa for uric acid) is a characteristic feature of idiopathic uric acid renal stone formerly named as “gouty diathesis” [15, 16]. In such an excessively acidic urinary environment, the concentration of sparingly soluble undissociated uric acid increases, resulting in the formation of uric acid stones by direct precipitation [17]. Calcium oxalate nephrolithiasis may also develop by heterogeneous nucleation of calcium oxalate by uric acid [18-20]. Based on the above observations, it has been proposed that resistance to insulin action in the kidney (“renal insulin Resistance”) may lead to excessive urinary acidification and formation of uric acid stones [12, 13, 21]. The purpose of the current study was to determine the effect of urinary pH and specific gravity on renal stone in different season’s .Renal stone is the third most common urological Problem affecting both males and females [22]. It has been reported that the prevalence of renal stone disease was 1 to 5% in Asia, 5 to 9% in Europe, 13% in North America, and 20% in Saudi Arabia [23, 24]. It has been estimated that in the Arabian peninsular countries such as Kuwait, United Arab Emirates (UAE) and Saudi Arabia, 20% of the males would have had at least one episode of urinary stone disease by the time they reached 60 years of age [25]. In Buenos Aires city, a nephrolithiasis prevalence of 4.3% in men and 3.6% in women [26] Urinary calculi analysis is important to determine the possible etiology of stone formation and the pathophysiology of Urolithiasis, as previously reported [27]. Stone analysis plays a valuable role in the diagnosis of kidney stone disease, specifically in uncommon kidney stones such as uric acid, cystine, infection-induced, drug-induced, and NH4-urate stones [28]. Urolithiasis is the consequence of multiple causative agents and risk factors [23]. Geographic, climatic and seasonal factors play a major role as causative agents on urinary tract calculi [29]. Many studies shown that urolithiaisis is a complex procedure closely related to personal habits, quality and quantity of drinking water, diet diversity and familial inheritance [30]. The higher incidence of uric acid lithiasis was due to excessive consumption of beef and alcohol or higher intake of protein as a part of their dietary life style in stone formers [31]. Specific dietary measures could be considered as non-pharmacological preventive measures for avoiding each type of renal calculus formation. These include an intake of a minimum two liters of water per day, a strict vegetarian diet, and avoiding excessive consumption of animal proteins, salt, Vitamin C and Vitamin D. Consuming phytate-rich products (natural dietary bran, legumes and beans, whole cereals) and preferably avoiding exposure to cytotoxic substances (i.e., analgesics abuse, residual pesticides, organic solvents and cytotoxic drugs) have been recommended to prevent the formation of stones [32]. The possibility of an individual of rising urinary stone disease may be analyzed from the biochemical risk factors such as urinary volume, pH and relative saturation of uric acid, which are exaggerated mainly by seasonal variation. The factors such as increased excretion of calcium, lower urine output, dehydration, diet, low urinary citrate, genetic factors, and environmental derangements (ambient temperatures) can contribute to increased urinary super saturation of salts, low urine pH and reduced urine volumes, leading to crystallization [33].Crystilluria caused by excessive loss of water leads to stone formation[34]. Crystilluria in early morning urine samples [35] is a risk factor of high predictive value for stone recurrence in calcium stone formers. Crystal precipitation is the outcome of all factors acting in urine, both advocates and inhibitors, and measured and unmeasured, activating crystal formation, which is the first step in stone formation. Increase in water intake can cause reduction of crystilluria and urinary density leading to decrease in risk of lithogenesis [36]. The pH of urine is normally close to neutral (29) but can vary between 4.4 and 8 over a period of 24 hours based on a variety of physiological factors. Uric acid and cystine calculi are formed in acidic urine while calcium oxalate calculi are formed with acidic, neutral and alkaline pH. Alkaline urine results in the formation of calcium phosphate and magnesium ammonium phosphate calculi [37]. The normal specific gravity of urine varies from 1.020 to 1.028 in a well hydrated person over a period of 24 hours. Bladder calculi usually cause dysuria, and to avoid pain during micturition the patients tend to reduce their daily fluid intake, raising the urine specific gravity [38]. High concentration of salts such as calcium oxalate, calcium phosphate, or uric acid leads to crystal formation or growth of preformed crystals [39]. The present study was conducted to explore the role of urine pH and specific gravity in the formation of urinary stones in Jalalabad.

Method and Material

This descriptive study was conducted among confirmed urolithiaisis patients reporting to the Department of Radiology and Urology of Nangarhar university Teaching. Records of Urolithiasis cases confirmed by ultrasonography during the period 2018 to 2019 .Data on patient's Age, sex, seasonality, anatomical sites of the stone, Biochemical Parameters such as urine color, deposit, pH, specific gravity, Albumen, Glucose, Pus cells, Red Blood Cells (RBCs) and crystals were obtained from case records after obtaining approval from Biochemistry and Microbiology Department & research Committee of Nangarhar Medical faculty. Light microscopy and qualitative chemical tests using Combi Multistix strips were employed for urine analysis. The data were analyzed using SPSS version 26.0. Non parametric ANOVA test was used to find whether the mean specific gravity and pH varied with anatomical site of stone and with different seasons.

RESULTS

The ages of participants ranged from 7 to 78 years with a mean age of (Mean±SD) (34±7.8) years. More than 60% of the patients were below 40 years of age. The majority of the subjects

(57.7%) were males, with only 42.3% being females. The age and gender distribution of patients with renal stone is given in Table 1.

Table 1. Age-and gender-wise Distribution of patients with urolithiaisis.

	Sex					
Age group	Male		Female		Total	
	No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
< = 40Years	26	63.4	22	73.3	48	67.6
>40 Years	15	36.6	8	26.7	23	32.4
Total	41	100.0	30	100.0	71	100.0

The urine parameters of 71 subjects who presented with Renal stone showed 1.4% as having normal pale yellow coloured urine while others had yellow (62.0%), dark yellow (36.6%). Urine analysis showed that only 46.5% of the urine samples contained deposits. Among the study subjects, 60.6% had acidic pH, 19.7% neutral and 19.7% alkaline pH values. The specific gravity of the samples was normal or below normal in 2.8% subjects, while it was above normal in 97.2% patients. 60.6% of urine samples showed the presence of albumin, and 5.6% of the samples the presence of glucose. Microscopic examination of urine revealed the presence of pus cells in 90.1% of the subjects. RBCs were found in 59.2% of urine samples; and crystals were found in 54.9% of the samples. The details are given in Table 2.

Table 2. Distribution of urine parameters in patients with renal stones

Urine parameters	Groups	Numbers	Percentages (%)
Color	Yellow	44	62.0
	Dark yellow	26	36.6
	Pale yellow	1	1.4
Deposit	Present	33	46.5
	Absent	38	53.5
pH	Acidic	43	60.6
	Alkaline	14	19.7
	Neutral	14	19.7
Specific gravity	Normal (1.020-1.028)	2	2.8
	Above normal(>1.028)	69	97.2
Albumen	Present	43	60.6
	Absent	28	39.4
Glucose	Present	4	5.6
	Absent	67	94.4
Pus cells	Present	64	90.1
	Absent	7	9.9
RBCs	Present	42	59.2
	Absent	29	40.8
Crystals	Present	39	54.9
	Absent	32	45.1

It was observed that 54.9% of the samples had crystalluria. The Urine parameters such as urine deposit, albumin, glucose, pus cells, RBCs and crystals were evaluated under acidic, neutral and alkaline pH. Urine deposits were detected to be comparatively high (85.7%) in neutral pH and low (21.4%) in alkaline pH. Albumin was absent in 57.1% of urine samples with alkaline pH and was spotted to be high (100%) in urine samples with neutral pH. Glucose was present in 7.1% of patients with neutral pH whereas the glucose level was normal in all patients with alkaline urine. In urine with neutral pH pus cells were not present in 7.1% of the samples and RBCs were absent in 35.7%. The presence of pus cells was comparatively higher (92.9%) in urine samples with alkaline pH than those with acidic pH (88.4%). RBCs were detected comparatively more (71.4%) in urine samples with alkaline pH when compared to urine samples with acidic pH (53.5%). The presence of crystals was also found to be higher under neutral pH. The details are given in Table 3.

Table 3. Distribution of urine parameters according to pH of urine

Urine parameters		Acidic pH		Neutral		Alkaline pH	
		No.	Percentage %	No.	Percentage %	No.	Percentage %
Deposit	Present	18	41.9	12	85.7	3	21.4
	Absent	25	58.1	2	14.3	11	78.6
Albumen	Present	23	53.5	14	100.0	6	42.9
	Absent	20	46.5	0	0.0	8	57.1
Glucose	Present	3	7.0	1	7.1	0	0.0
	Absent	40	93.0	13	92.9	14	100.0
Pus cells	Present	38	88.4	13	92.9	13	92,9
	Absent	5	11.6	1	7.1	1	7.1
RBCs	Present	23	53.5	9	64.3	10	71.4
	Absent	20	46.5	5	35.7	4	28.6
Crystals	Present	22	51.2	13	92.9	4	28.6
	Absent	21	48.8	1	7.1	10	71.4

The specific gravity of urine was also compared with urine parameters such as urine deposit, albumin, glucose, pus cells, RBCs and crystals. The deposits were found to be higher in urine samples with above normal specific gravity than in those with normal/below normal specific gravity. Albumin was present in 100% of urine samples with normal or below normal specific gravity, but in patients with above normal specific gravity, the presence of albumin was detected in 60.9%. Among stone formers with urine specific gravity values above normal (>1.028), pus cells were found in 89.9%, RBCs in 59.4% and crystals in 56.5% which are comparatively higher than in patients with urine of normal/below normal specific gravity. The details are given in Table 4.

Table 4. Distribution of urine parameters according to urine specific gravity.

Urine parameters		Normal /below normal		Above normal	
		No.	Percentage %	No.	Percentage %
Deposit	Present	0	0.0	33	47.8
	Absent	2	100.0	36	52.2
Albumen	Present	1	50.0	42	60.9
	Absent	1	50.0	27	39.1
Glucose	Present	0	0.0	4	5.8
	Absent	2	100.0	65	94.2
Pus cells	Present	2	100.0	64	89,9
	Absent	0	0.0	7	10.1
RBCs	Present	1	50.0	41	59.4
	Absent	1	50.0	28	40.6
Crystals	Present	0	0.0	39	56.5
	Absent	2	100.0	30	43.5

The mean pH of urine samples from patients with stones located at different anatomical sites revealed that the lowest pH was observed in patients with stones in renal pelvis in the case of males and stones in the ureters in the case of females. The highest pH was observed in patients with stones in renal calyces, both in the case of males and females. The mean specific gravity of urine was observed to be high in patients with stones in the renal pelvis and renal calyces and lowest with stones in ureter among male, but the highest was observed in patients with stones in ureter and urinary blladder and lowest with stones in renal calyces and renal pelvis among females (Table 5).

Table 5: Distribution of urine specific gravity and pH according to anatomical location of stone

Location,	pH				Specific gravity			
	Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ureter	6.27	0.592	5.70	0.395	1.0233	0.00562	1.0378	0.03218
Renal calyces	6.42	0.417	6.13	0.816	1.0248	0.00571	1.0233	0.00699
Renal pelvis	6.20	0.274	6.10	0.566	1.0258	0.00870	1.0257	0.00345
Urinary bladder			5.75	1. 061			1.0225	0.01061

Nonparametric Kruskal-Wallis Test showed that there was no statistically significant difference in urine pH and specific gravity in patients with stones in different anatomical sites. On testing the correlation between pH and specific gravity using spearman's correlation test showed that there was no statistically significant correlation between pH and specific gravity in urine.

The analysis of the effect of seasonality on specific gravity, with the year divided into summer and winter, showed that specific gravity during the summer season was comparatively high compared to that in winter. The difference observed was not statistically significant. With regard to pH, during winter the mean pH was high when compared to that in summer. The difference observed was not statistically significant. Comparing specific gravity and pH, the highest mean specific gravity was observed in summer and the highest mean pH in winter. On comparing the mean specific gravity in crystalluric and non crystalluric patients, an increasing trend was observed from urine with crystalluria.

Table 6. Distribution of urine specific gravity and pH according to season and crystilluria

Variables		pH		Specific gravity	
		Mean	SD	Mean	SD
Season	Summer	6.06	0.666	1.0253	0.01284
	Winter	6.48	0.274	1.0252	0.00594
Crystalluria	Present	6.06	0.642	1.0260	0.01360
	Absent	6.36	0.509	1.0244	0.00684

On comparing the mean pH with crystalluria a negative trend was observed, an increased pH for urine without crystals and a decreased pH for urine with crystals urine. The details are given in Table 6.

DISCUSSION

The purpose of our study was to examine the association between urinary pH and specific gravity a number of patients with nephrolithiasis evaluated at university Teaching hospital & Nangarhar public hospital. Renal stone formation is the condition of stone formation in the urinary system, including ureter, kidney, and bladder [34].

Crystal formation depends mainly on the composition of urine, as urine is a metastable liquid containing several coexisting substances that can crystallise to generate renal calculi [40].

The anatomy of the upper and lower urinary tract may also influence the likelihood of stone formation [41].

In our present study the majority of renal stone formers (67.6%) were below 40 years of age, with a male to female ratio of 2:1 and over 40 years age of male patients 36.6% and 32.4% were female formers of renal stones ,with male to female ration 2:1 .Studies conducted by Alsheyab et al. in Jordan and Kumar et al. in Nepal discovered that male predominance was seen with a ratio of 3:1 and that urinary stone disease was most common within the age group 20-50 years. The male to female ratio observed in the present study is high compared to other studies. The studies from other parts of the world show that stone disease not only affects the patients, but also the countrywide economy, as the disease is prevalent in the productive age group20. In the present study it was observed 54.9% of the patients had crystals and 45.1% doesn't have crystals. Sperling et al. and Tiselius et al. showed high frequency of acidic urine in patients living in Israel, the Arabian countries, and Australia compared to Northern Europe. Episodes of excessive fluid loss or reduced intake might be associated with an obvious risk of uric acid crystallization. Lowering of pH and urine volume can lead to the precipitation of uric acid at a normal excretion of urate [35,39] In our study the in lower urinary pH the renal stone formation is (60.6%), in alkali and neutral pH (19.7%) is equal. In the 2.8% of renal stone disease has the normal specific gravity and 97.2% of the patients has abnormal specific gravity. Which is in accordance with the study conducted by Kumar et al.10. It also shows that uric acid solubility decreases dramatically at a urinary pH lower than 5.5, leading to uric acid crystal formation. The solubility of calcium oxalate is affected by the changes in the urinary pH leading to its super saturation and crystallization [34]. The urine samples showed an increase in specific gravity during the summer season with a decrease during the winter. This is in accordance with the studies of Rabie et al., proving the effect of seasonal variations in temperature on urinary volume, pH and saturation [1].

CONCLUSSION

In finding of the present study determine the relation between pH and specific gravity in urinary stone formers, emphasizing the role of an increase in specific gravity and decrease in pH in the formation of urinary stone diseases. The study also showed an increase in specific gravity and decrease in pH of urine during summer season, which may be a contributing factor for renal stone formation. The main reason for the increased specific gravity during summer appears to be dehydration as indicated by the presence of high colored urine (yellow).

References

1. Rabie E, Halim A. Urolithiasis in adults clinical and biochemical aspects. Saudi Med J. 2005; 26:705 13.
2. Asplin JR. Nephrolithiasis: introduction. *Semin Nephrol* 2008; 28: 97-8.
3. STAMATELOU KK, FRANCIS ME, JONES CA, *et al*: Time trends in reported prevalence of kidney stones in the United States: 1976–1994.*Kidney Int* 63:1817–1823, 2003
4. YOSHIDA O, TERAI A, OHKAWA T, OKADA Y: National trend of the incidence of Urolithiasis in Japan from 1965 to 1995. *Kidney Int* 56:1899–1904, 1999.
5. SERIO A, FRAIOLI A: Epidemiology of nephrolithiasis. *Nephron* 81 (Suppl 1):26–30, 1999
6. FLEGAL KM, CARROLL MD, OGDEN CL, JOHNSON CL: Prevalence and trends in obesity among US adults, 1999–2000. *JAMA*288:1723– 1727, 2002
7. KOPELMAN PG: Obesity as a medical problem. *Nature* 404:635–643, 2000
8. WORLDHEALTHORGANIZATION: *Obesity: Preventing and Managing a Global Epidemic,* Geneva, World Health Organization, 2000, Technical Report Series no. 894
9. GOLDFARB DS: Increasing prevalence of kidney stones in the United States. *Kidney Int* 63:1951–1952, 2003.
10. NISHIO S, YOKOYAMA M, IWATA H, *et al*: Obesity as one of the risk factors for Urolithiasis. *Nippon Hinyokika Gakkai Zasshi* 89:573– 580, 1998
11. CURHAN GC, WILLETT WC, RIMM EB, *et al*: Body size and risk of kidney stones. *J Am Soc Nephrol* 9:1645–1652, 1998
12. SAKHAEE K, ADAMS-HUET B, MOE OW, PAK CY: Pathophysiologic basis for normo uricosuric uric acid nephrolithiasis. *Kidney Int* 62:971–979, 2002
13. ABATE N, CHANDALIA M, CABO-CHAN AV, *et al*: The metabolic syndrome and uric acid nephrolithiasis: Novel features of renal manifestation of insulin resistance. *Kidney Int* 65:386–392, 2004
14. PAK CY, SAKHAEE K, MOE OW, *et al*: Biochemical profile of stone forming patients with diabetes mellitus. *Urology* 61:523–527, 2003
15. KHATCHADOURIAN J, PREMINGERGM, WHITSONPA, *et al*: Clinical and biochemical presentation of gouty diathesis: Comparison of uric acid versus pure calcium stone formation. *J Urol* 154:1665–1669, 1995
16. PAK CY, SAKHAEE K, PETERSON RD, *et al*: Biochemical profile of idiopathic uric acid nephrolithiasis. *Kidney Int* 60:757–761, 2001
17. PAK CY, WATERS O, ARNOLD L, *et al*: Mechanism for calcium Urolithiasis among patients with hyperuricosuria: Supersaturating of urine with respect to monosodium urate. *J Clin Invest* 59:426–431, 1977.
18. COE FL, KAVALACH AG: Hypercalciuria and hyperuricosuria in patients with calcium nephrolithiasis. *N Engl J Med* 291:1344–1350, 1974
19. PAK CY, ARNOLD LH: Heterogeneous nucleation of calcium oxalate by seeds of monosodium urate. *Proc Soc Exp BiolMed*149:930–932,1975
20. COE FL, STRAUSS AL, TEMBE V, LE DUN S: Uric acid saturation in calcium nephrolithiasis. *Kidney Int* 17:662–668, 1980
21. MOE OW, ABATE N, SAKHAEE K: Pathophysiology of uric acid nephrolithiasis. *Endocrinol Metab Clin North Am* 31:895–914, 2002.
22.Stamatiou KN, Karanasion VI, Lacrois RE, Kavouras NG, Papadimitriou VT, Chlopsios C, et al. Prevalence of urolithiasis in rural Thebes, Greece. Rural Remote Health. 2006; 6:610.
23.Kim H, Jo MK, Kwak C, Park SK, Yoo KY, Kang D, et al. Prevalence and epidemiologic characteristics of Urolithiasis in Seoul, Korea. Urology. 2002; 59:517-21.

24.Lee YH, Huang WC, Tsai JY, Lu CM, Chen WC, Lee MH, et al. Epidemiological studies on the prevalence of upper urinary calculi in Taiwan. Urol Int. 2002; 68:172-7.
25.Ghafoor M, Majeed I, Nawaz A, Al-Salem A, Halim A. Urolithiasis in the pediatric age group. Ann Saudi Med. 2003; 23:201-5.
26. Pinduli I, Spivacow FR, del Valle EE, et al. Prevalence of Urolithiasis in the autonomous city of Buenos Aires, Argentina. *Urol Res* 2006; 34: 8-11.
27.Anderson RA. A complementary approach to Urolithiasis prevention. *World J Urol* 2002; 20: 294-301.
28. Sakhaee K, Maalouf NM, Sinnott B. Kidney stones: pathogenesis, diagnosis, and management. *J Clin Endocrinol Metab* 2012; 97: 1847-60.
29.Hiatt RA, Dales LG, Friedman GD, Hunkeler EM. Frequency of urolithiasis in a prepaid medical care program. Am J Epidemiol. 1982; 115:255-65.
30.Unal D, Yeni E, Verit A, Karatas OF. Prognostic factors effecting on recurrence of urinary stone disease: a multivariate analysis of everyday patient parameters. Int Urol Nephrol. 2005; 37:447-52.
31.Cameron MA, Charles YC. Approach to the patient with the first episode of nephrolithiasis. Clinical Reviews in Bone and Mineral Metabolism. 2004; 2:265-78.
32. Kumar A. Urine examination for calculogenic crystals--a newer approach using refrigeration. Trop Doct. 2004; 34:153-5
33. National Aeronautics and Space Administration. Evidence book. Risk of renal stone formation. Houston: Lyndon B Johnson Space Center; 2008.
34. Robertson WG, Peacock M. The cause of idiopathic calcium stone disease: Hypercalciuria or hyperoxaluria. Nephron. 1980; 26:105-10.
35. Tiselius HG. Risk formulas in calcium oxalate urolithiasis. World J Urol. 1997; 15:176-85.
36.Daudon M, Hennequin C, Boujelben G, Lacour B, Jungers P. Serial crystalluria determination and the risk of recurrence in calcium stone formers. Kidney Int. 2005; 67:1934-43.
37..McCann JA, Schilling RN. Professional guide to diseases. 8th ed. London: Lippincott Williams and Wilkins Publishers; 2005.
38.Basler J, Ghobriel A. Bladder Stones. eMedicine [Online]. 2004- [Cited 4 April 2010]. Available from: URL: http://www.arabmedmag.com/issue-30-04-2005/urology/main03.htm.
39. Cerini C, Geider S, Dussol B, Hennequin C, Daudon M, Veesler S, et al. Nucleation of calcium oxalate crystals by albumin: Involvement in the prevention of stone formation. Kidney Int. 1999; 55:1776-86.
39. Sperling O. Uric acid nephrolithiasis. In: Wickham EA, Buck AC, editors. Renal tact stone - Metabolic basis and clinical practice. Edinburgh: Churchill Livingstone; 1990. p. 349-65.
40. Ansari MS, Gupta N P. Impact of socioeconomic status and management of urinary stone disease. Urol Int. 2003;70:255-61.
41. Litwin MS, Saigal CS. Urologic Diseases in America. Washington, DC, US Government Publishing Office, NIH Publication No. 04-5512, 2004; 283-316.