PREVALENCE OF URINARY TRACT CALCULI AND THE QUALITATIVE ANALYSIS OF THEIR CHEMICAL COMPOSITION OF PATIENTS WITH UROLITHIASIS IN THI - QAR GOVERNORATE / IRAQ

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ABSTRACT

Objectives: The present study was conducted to evaluate the prevalence of urolithiasis in relation to patients six, age, and anatomical distribution of stones and to assess the chemical composition of urinary stones qualitatively to identify common type of urinary stone which prevalence in Nasiriyah city and how can provide the recurrence of stone formation if possible.

Methods: Forty-four calculi obtained from 29 males and 15 females afflicted with Urolithiasis and admitted at Al Hussein Teaching Hospital, Thi-Qar governorate, Nasiriyah city, Iraq, from July 2010 to September 2011. Their ages ranged from 30 to 60 year. All samples analyzed qualitatively for ammonia, magnesium, phosphate, magnesium ammonium phosphate, carbonate, calcium salts (oxalate and non-oxalate), uric acid, xanthine, and cystine by adopting standard methods.

Results: The study results showed that, the prevalence of stones was more in males (65.91%) than females (34.09%) with male to female ratio of 1.93:1 and the high occurrence in patients aged from 30 to 50 years. The anatomical distribution of urinary stones showed high percent in kidneys 52.27 % (23 patients) and bladder 47.73 % (21 patients), but it is absent in ureters and urethral (0.00 %). All the stones were of mixed type, of these stones contained 42 (95.46 %) calcium salts (oxalate and non oxalate), uric acid, and ammonium ion, 41(93.18 %) phosphate, 33 (75.00%) magnesium and magnesium ammonium phosphate (MAP), 29 (65.91%) carbonate, 26 (50.00) xanthine, and 7 (15.91 %) cystine. In addition, there are no differences in the chemical combustion between kidneys and bladder stones.

Conclusion: Urolithiasis in Nasiriyah is a problem with high frequency in men than women and usually described as more frequent in age ranged 30 to 50 year and in kidneys and bladder than ureters and urethral. The majority of urinary stones types had a mixed type in which calcium salts (oxalate and non-oxalate), uric acid, ammonia phosphate and struvite were the predominant constituents related that both the metabolic disturbances and bacterial infection causes, which have the same majority and effect in the stone formation.

Keywords: Urolithiasis, The chemical composition of urinary tract calculi

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INTRODUCTION

Urolithiasis is a common world problem and a complex process that involves multiple factors. The sequence of events leading to urinary calculi formation is as follows:

Saturation → Super saturation → Nucleation → Crystal growth→ or Aggregation → Crystal retention → Stone formation [1,2]. The stones are frequently composed of nucleus surrounded by the layers. Uroliths found in kidneys, ureters, bladder, or urethra. They vary considerably in size from small "gravel" like stones to large "staghorn" calculi. The calculi may stay in the position in which are formed, or migrate down the urinary tract producing symptoms along the way [3]. Generally, renal calculi are divided into two categories, pure (simple), and mixture (compound) calculi [4]. Most authorities believe that, the most important driving force behind calculi formation is the state of super saturation of urine [2]. Also, may be due to age, sex, metabolic disturbances, infections, hormonal influences, dietary conditions and habits, poor fluid intake which concentrates and decreases the urine volume, immobilization or lesions or obstructions in the bladder or kidney or increased excretion of stone forming components such as calcium, oxalate, carbonate, phosphate, urate, xanthine, cystine, etc [5]. The present study was undertaken to evaluate the prevalence of stone formers in relation to patient's sex, age and location of stone in urinary tract and qualitatively analyzed the chemical composition to identify the common type of urinary tract calculi and how can provide the recurrence of stone formation if possible.

MATERIALS & METHODS

Forty-four stone samples had obtained from patients admitted at Al Hussein Teaching Hospital, Thi-Qar governorate, Nasiriyah, Iraq, from July 2010 to September 2011. Questionnaires had completed covering the information pertaining to age, sex, and the anatomical distribution of the stones. The forty - four stones which had been washed, dried and crushed were analyzed qualitatively for ammonia, magnesium, phosphate, ammonium magnesium phosphate, carbonate, calcium oxalate, non-oxalate calcium, uric acid, xanthine, and cystine by adopting standard methods [6].

RESULTS:

Age and sex of urolithiasis cases recorded in Table 1. Out of 44 patients, ٢٩ were males and ١٥ were females. The age ranged from 30 to 60 year with the mean of 41.58 years. Age wise, maximum incidence has surfaced for middle-aged persons (30 to 50 years). Sex wise breakup of urolithiasis cases reveal a greater percentage of males affected by this disease. The incidence among females seems to be (34.09%) as compared to males (65.91%).

Distribution of urinary stones in relation to their site or location in the urinary tract mentions in Table 2, it's showed 23 (52.27%) kidney, 21(47.73%) bladder, 0.00 (0.00 %) ureters, and 0.00 (0.00 %) urethra stones.

Table 3 and figure 1 show the composition of the forty-four stones, all stones had found to be of mixed crystalloid composition (100.0%) and no pure stone had found (0.00%). The mineralogical composition of the urinary stones had found to be as follows: calcium salts (oxalate and/or non-oxalate), uric acid (urate) and ammonium ion occur with the same percentage 95.46 % followed by

93.18 % phosphate, 75.00% magnesium, 75.00% magnesium ammonium phosphate (MAP), 65.91% carbonate , 50.00 % xanthine, and 15.91 % cystine.

Table 4 and fig. 2 show no differences in the chemical composition among all substances between kidneys and bladder stones.

DISCUSSION:

Urolithiasis is an ancient disease with global distribution and has perplexed human beings and physicians for many centuries [7]. The calculi occurred more commonly in males may be due to smaller diameter and increased length of urethra [8]. In addition, the lower risk of urinary calculi formation in female may be due to the decreased urinary saturation with calculi forming salts [9]. Generally, it accepted that stones occur more commonly in males than females. Our findings corroborate with this sex difference as reported by others [10, 11]. One of the interesting features of our study is the high occurrence of renal stones in the age group of 30 - 50 years. The reason/s is not clear but one of the strong possibilities is high intake of non-vegetarian food accompanied with lower intake of water and fluids, smoking, urinary tract infections, excess calorie intake, chocolates, tea, and high consumption of fruits and vegetables rich in oxalates [12, 13]. Many earlier studies from different geographical areas of world, reported recurrence of Urolithiasis had multi etiological and risk factors as urinary stasis. Therefore, the occurrences of stones were more commonly in the kidneys and bladder, while the ureters and urethral are just passage of urine. Stones present in ureters and urethral if there is an obstruction in these locations, so there are no ureters and urethral stone in this study. These results are inconsistent with those reported by others [14]. The presence of mixed stones suggests a multi factorial etiology [15,16]. The majority of these stones in this study were composed of 95.46 % for all calcium salts layers (Oxalate and non-oxalate), uric acid layer, and ammonia layers followed by phosphate layer with 93.18%. Some of the reasons for this results, might be as follows, non-vegetarian diets (animal protein lowers citrate excretion and increases calcium and uric acid excretion) [17] (ii) diet with high oxalate content (iii) high carbohydrate intake (especially rice), which provides acidic medium to urine favoring calcium oxalate stone formation (iv) water quality; its mineral content and high fluoride levels[18-20]. Fluoride said to be a mild promoter of urinary stone formation by increasing oxalate excretion in urine, excretion of insoluble calcium fluoride and mildly increasing the oxidative burden [20]. Besides nutritional and environmental factors, genetic factors also contribute to stone formation [19]. The high occurrence of ammonia layers (95.46%) and phosphate layer (93.18%) associated with urinary tract infections specially, the presence of urase-producing bacteria including *Ureaplasma urealyticum* and *Proteus* species (most common), *Staphylococcus* species, *Klebsiella* species, *Providencia* species, and hydroxyl ions. As below [8]:

$$H_2NCONH_2 + H_2O \xrightarrow{\text{Urease}} 2\,NH_3 + CO_2$$
$$2NH_3 + H_2O \longrightarrow 2NH^{4+} + 2OH^-$$
$$CO_2 + H_2O \longrightarrow H^+ + HCO_3 \longrightarrow 2H^+ + CO_3^{2-}$$

The resulting increase in ammonium and phosphate concentrations combined with the alkalotic urine (pH > 7.2), which are necessary for struvite (Magnesium ammonium phosphate ($MgNH_4PO_4.6H_2O$))

formation and admixed with carbonate apatite [8]. Struvite stone layers (MAP) occurred with 75.00% but ammonia and phosphate the essential component of it occurred with high percent (95.46%). This diminution in the percent related to the magnesium ions concentration or percent (75.00%). High dietary intake of magnesium appears to reduce the risk of stone formation somewhat, because like citrate, magnesium is also an inhibitor of urinary crystal formation [21] and a low magnesium intake were predictive of stone formation [22]. Therefore, metabolic factors and diet appear to be important in the formation of struvite calculi. From the results, the most important causes behind calculi formation are metabolic disturbances and infections, which have the same majority and effects. Xanthine calculi are uncommonly encountered stones. When Xanthine layers occurs, it typically do so in association with inborn metabolic disorders such as hereditary xanthi-nuria or Lesch-Nyhan syndrome. They may also occur in association with states of prof-ound hyperuricemia [23]. Cystine layer's represent in 15.91% of all urinary calculi, the presence of these stones is more likely caused by cystinuria, an autosomal recessive disease affecting the transport of the dibasic amino acids: cystine, ornithine, arginine and lysine in the proximal convoluted tubules. This results in excessive secretion of these dibasic amino acids in the urine. Only cystine is insoluble, especially in acidic conditions [24]. The composition of stones may also differ in different climed and countries [25]. In our study, the percentage incidence of magnesium ammonium phosphate, calcium oxalate ,non-oxalate calcium, uric acid and cystine is higher than that reported in Baghdad [26] In Saudi Arabia, the pure stones were the major type. Calcium oxalate stones were the commonest followed by uric acid and phosphate stones [27]. In Dubai, calcium oxalate had found in 78% of patients with bladder calculi and acute urinary retention as the most common presenting symptom of bladder stones [28]. In Karad, India, The chemical analysis of uroliths showed that all the assessed stones were of mixed heterogeneous type, magnesium ammonium phosphate (71.2%) was predominant constituent followed by calcium oxalate (68.8%), calcium carbonate (64.0%), urate (44.8%), cystine (12.8%), and xanthine (2.4%) [29]. In Okinawa (Japan) uric acid stones, predominantly showed a relatively high frequency [30]. Upper urinary tract stones are relatively uncommon in Nigeria probably had been related to chronic dehydration exacerbated by religious fasting [31]. In Thailand, oxalate had found in most upper urinary tract stones and uric acid had found in lower urinary tract stones [32].

CONCLUSION:

Urolithiasis in Nasiriyah is a problem with high frequency in men than women and usually described as more frequent in age ranged 30 to 50 year and in kidneys and bladder than ureters and urethral. The majority of urinary stones types had a mixed type in which the calcium salts (oxalate and non-oxalate), uric acid, ammonia phosphate and struvite were the predominant constituents. From the results, the most important causes behind calculi formation are metabolic disturbances, and bacterial infections, which have the same majority and effects.

Table 1 .The distribution of urinary tract stone in relation to patient's age and sex.

Age Group in Years	Number of cases		Total number of cases (%)
	Male (%)	Female (%)	
30 - 40	11 (25.00)	6 (13.64)	17 (38.64)
41-50	13 (29.55)	7 (15.92)	20 (45.45)
51-60	5 (11.36)	2 (4.55)	7 (15.91)
Total	29 (65.91)	15 (34.09)	44 (100.00)

Table 2. The distribution of Renal Calculi in relation to their site or location in the urinary tract

Stone location	Total number (Percent of occurrence)
Kidneys	23 (52.27)
Ureters	0 (0.00)
Bladder	21 (47.73)
Urethra	0 (0.00)
Total	44 (100.00)

Table 3 . The chemical composition of different forty-four urinary tract stones

The chemical composition	Total number of positive results (%)
Ammonia	42 (95.96)
Calcium oxalate	42 (95.46)
Non oxalate – calcium	42 (95.46)
Uric acid	42 (95.46)
Phosphate	41 (93.18)
Magnesium	33 (75.00)
Magnesium ammonium phosphate	33 (75.00)
Carbonate	29 (65.91)
Xanthine	26 (50.00)
Cystine	7 (15.91)

Table 4 The differences in the composition between kidneys and bladder stones

Substances	Number of positive results	
	Kidneys(n= 23)	Bladder (n=21)
Ammonia	21	21
Calcium oxalate	22	20
Non oxalate – calcium	22	20
Uric acid	22	20
Phosphate	21	20
Magnesium	17	16
Magnesium ammonium phosphate	17	16
Carbonate	14	15
Xanthine	12	10
Cystine	3	4

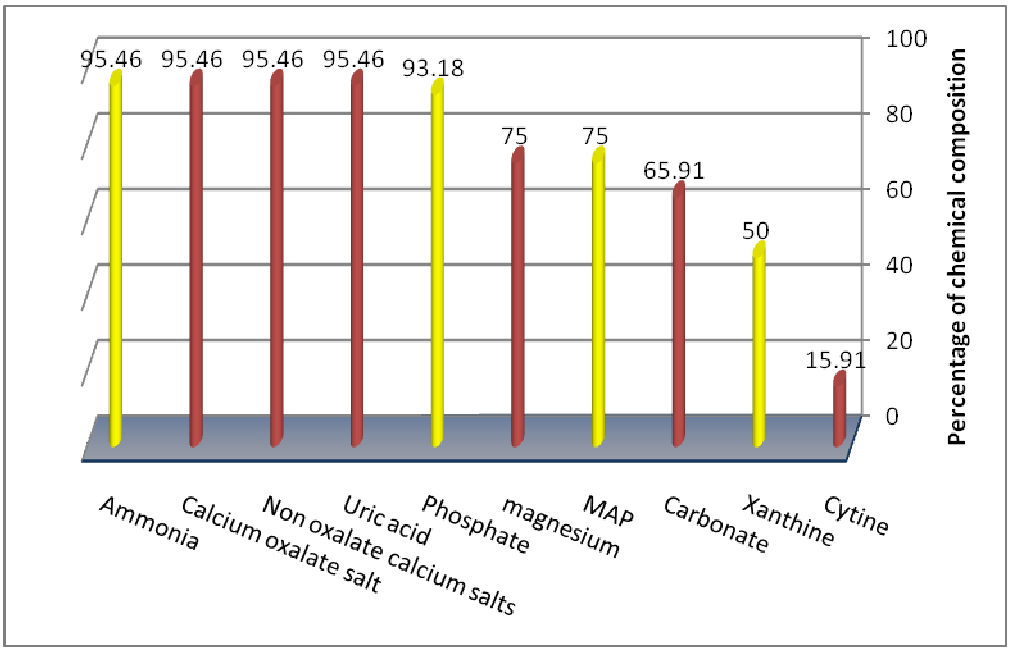

Fig. 1 The chemical composition of different forty-four urinary tract stones

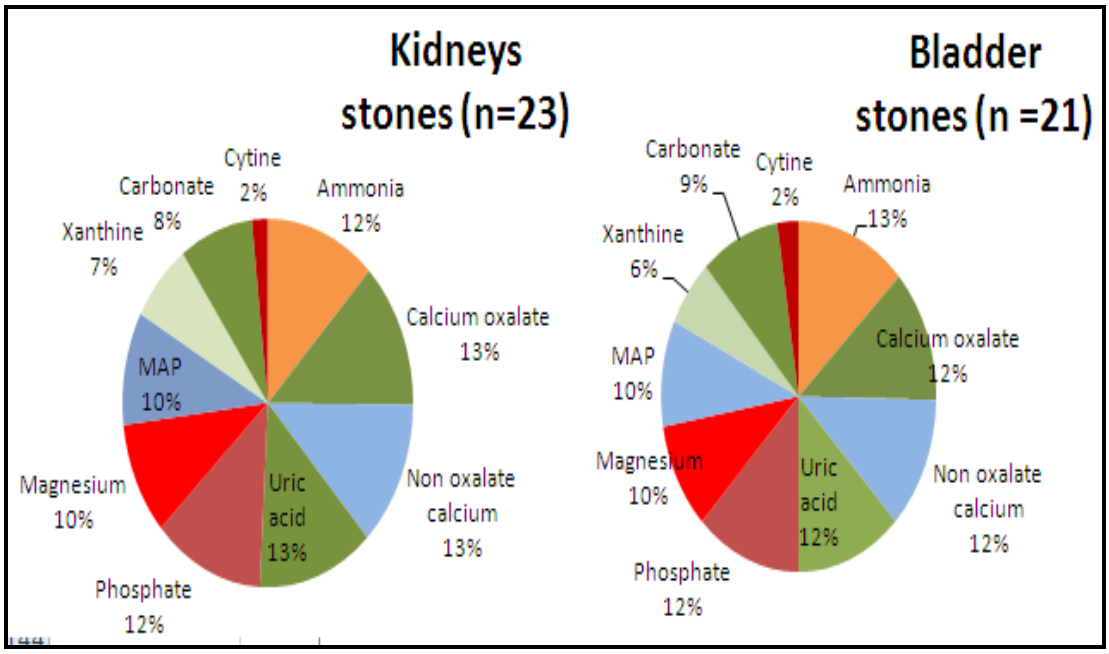

Fig. 2 The differences in the chemical composition percentage between kidneys and Bladder stones

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معدل انتشار حصى المجاري البولية والتحليل النوعي لمكوناتها الكيميائية لدى مرضى المجاري البولية في محافظة ذي قار / العراق

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الخـــــــلاصة

الأهـداف صممت الدراسة الحالية لتحديد انتشار مرض حصى المجاري البولية نسبة إلى الجنس والعمر و موقع الحصى ضمن الجهاز البولي للمرضى و لتحديد المكونات الكيميائية باستخدام طرق التحليل النوعي لغرض تحديد النوع الأكثر انتشارا في مدينة الناصرية وكيفية منع تكرار تكون الحصى أذا أمكن ذلك.

طـــريقة العمل أربعة وأربعون حصى قد جمعت من ٢٩ رجل و ١٥ امرأة مصابين بحصى المجاري البولية راقدين في مستشفى الامام الحسين (ع) التعليمي، محافظة ذي قار،مدينة الناصرية ،العراق ضمن فترة تتراوح من تموز ٢٠١٠ و لغاية ايلول٢٠١١ ، تتراوح أعمارهم من ٣٠ إلى ٦٠ سنة. جميع النماذج تم تحليلها نوعيا للمكونات التالية امونيا ، مغنيسيوم ، فوسفات ،مغنيسيوم امونيوم فوسفات ، كاربونات، املاح الكالسيوم (اوكزالات و غير الاوكزالات)، حامض اليوريك ، ، زانثين و سستين بستخدام طرق قياسية .

ألنتـــــائج أظهرت نتائج الدراسة أن تكوين حصى المجاري البولية لدى الرجال (65.91%) أكثر من النساء (34.09%) وبنسبة الرجال إلى النساء (1.93 :1) و أكثر انتشار لدى المرضى ذوي الأعمار من ٣٠ إلى ٥٠ سنة . كما أظهرت النتائج أن انتشار الحصى ضمن الجهاز البولي أعلى نسبة كانت عند الكليتين 23 (52.27 %) والمثانة ٢١ (47.73 %) وانعدام ظهورها عند الحالب والاحليل ٠.00 (0.00%).

جميع نماذج الحصى كانت من النوع المركب ، تحوي 42 (95.46 %) أملاح الكالسيوم (اوكزالات / غير الاوكزالات)، حامض اليوريك، ايون الامونيوم ، ٤١ (93.18 %) فوسفات ، 33 (75.00%) مغنيسيوم ، ٣٣(75.00%) مغنيسيوم امونيم فوسفات (MAP) , ٢٢ (50.00 %) زانثين ، 29 (65.91%) كاربونات ، 7 (15.91 %) السستين. كذلك لايوجد فرق بين نسب المكونات السابقة بين حصى الكليتين والمثانة.

الاستنتاجات إن مشكلة حصى المجاري البولية في مدينة الناصرية كانت أكثر انتشارا لدى الرجال مما هو عند النساء خصوصا الفئات العمرية من ٣٠ الى ٥٠ سنة وبنسبة عالية في الكليتين و المثانة وانعدام ظهورها في الحالبان والاحليل . النوع الأكثر شيوعا لمكونات الحصى هو النوع المركب وتشكل فيه املاح الكالسيوم (الاوكزالات وغير الاوكزالات) وحامض اليوريك والامونيا و الفوسفات والستر وفيت النسبة الأعلى في التكوين مما يدل على أن كل من الاضطراب الايضي والإصابة البكتيرية لها نفس السيادة والتأثير في تكوين الحصى .

الكلمة المفتاح: مرض حصى المجاري البولية ، المكونات الكيميائية لحصى الجهاز البولي.

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