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Crystalluria types and incidence in Basra City; southern of Iraq

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Abstract

In Basra City, Southern of Iraq there was increase in the incidence of urinary tracts problems, these problems include frequent urinary tract infection and crystalluria .

The purpose from our study is to find out which predominant types of crystalluria and which gender and age has higher incidence values ; where 328 urine samples for males [n=91] and females [n=237] of different ages where analyzed by general urine examination, and sediment was identified by polarized optic microscope to differentiate types of crystals. The average age of patients, expressed as mean \pm standard deviation, was [38.05 \pm 17.57], and age range extended from \leq 9-80 years and divided into seven age groups from \leq 9 years old to equal to or greater than 60 years old .The data was analysed statistically by using *t* test and chi analysis of frequency at $p < 0.05$. The results showed only two types of crystalluria are found. Which is uric acid that represented 96.03% and Calcium oxalate that represented 3.97 %. There was no cysteine, or struvite crystals. Incidence percentage of uric acid crystals was greater in both genders (95.6% for males and 96.2% for females) as compared with the incidence percentage of calcium oxalate (4.4% for males and 3.8% for females) , and there was no significant difference between males and females in the incidence percentages for each type of crystalluria .

The patients samples were then divided into seven age groups from \leq 9 years old to equal to or greater than 60 years old and there were no significant differences (at $p < 0.05$) among all age groups in the incidence percentage of each type of crystalluria.

Our finding there were only two types of crystalluria are most predominant ; those are uric acid and calcium oxalate and the incidence of uric acid crystalluria was significantly greater than oxalate in both genders and age groups, which may be greatly different from that reported in several studies outside country .

Key-words: Crystalluria , Uric acid crystals , Calcium oxalate crystals

1. Introduction

Crystalluria is a frequently found during the routine examination of urine sediments [1]. In most instances the precipitation of crystals is caused by transient super saturation of the urine, ingestion of foods, or by changes of urine temperature and/or pH which occurs upon standing after micturition [1]. Formation of these crystals in urine is the necessary initial step of urolithogenesis in every type of urinary stone disease [2]. The formation of stones is always preceded by crystalluria, although crystalluria may occur without resulting in stone formation, but some authors proposed crystalluria as an index of stone disease activity in the early seventies [3], where Stone formers have been shown to exhibit more frequent crystalluria, with larger crystals and more numerous and larger crystal aggregates than healthy subjects [4]; Therefore, one could hypothesize that the presence of persistent crystalluria reflects a propensity for stone formation and may constitute a marker of stone disease activity of potential clinical relevance.

The most common types of urine crystals may include:

Calcium oxalate crystals; their formation is a multifaceted and complex process that involves a series of chemical, physical, biochemical, and physiological events [5]. The principal causative agent for the formation of calcium salt crystals is thought to be super-saturation that causes the precipitation of salts in urine. However, even though urine is supersaturated with calcium and oxalate ions in normal subjects, stones do not form because of the

presence of inhibitors and other unknown mechanisms [6]. Calcium oxalate crystals form in acidic to neutral urine [7]. They are also colourless and have an envelope or dumbbell shape [8]; see figure 1. And they may be associated ethylene glycol toxicity [9]. Amorphous urate crystals are seen in acidic to slightly alkaline urine. They form a granular precipitate

which may be normal or associated with liver disease.

Uric acid crystals are very pleomorphic, but the rhomboidal shape is the most frequent. Distinctive morphological features are the amber coloured and the constant poly-chromatic birefringence) see figure 1. (These crystals can be found both in normal subjects as well as in stone formers may appear as yellow to brown rhombic or hexagonal plates, needles or rosettes. [1]

Struvite crystals are sometimes called triple phosphate or ammonium magnesium phosphate crystals. They can be formed in urine with a wide range of pH, from slightly acidic to alkaline. In appearance, they have a colorless "coffin lid" shape, although they may dissolve into bizarre shapes. They are also associated with urinary tract infections and urolithiasis [1].

Cystine crystals form in acidic to neutral urine. They are colorless hexagons and are most often seen as a congenital defect in Dalmations [10]. Most common crystals that frequently seen in urine of normal individuals are calcium oxalate, calcium phosphate, and sodium urate. [11]

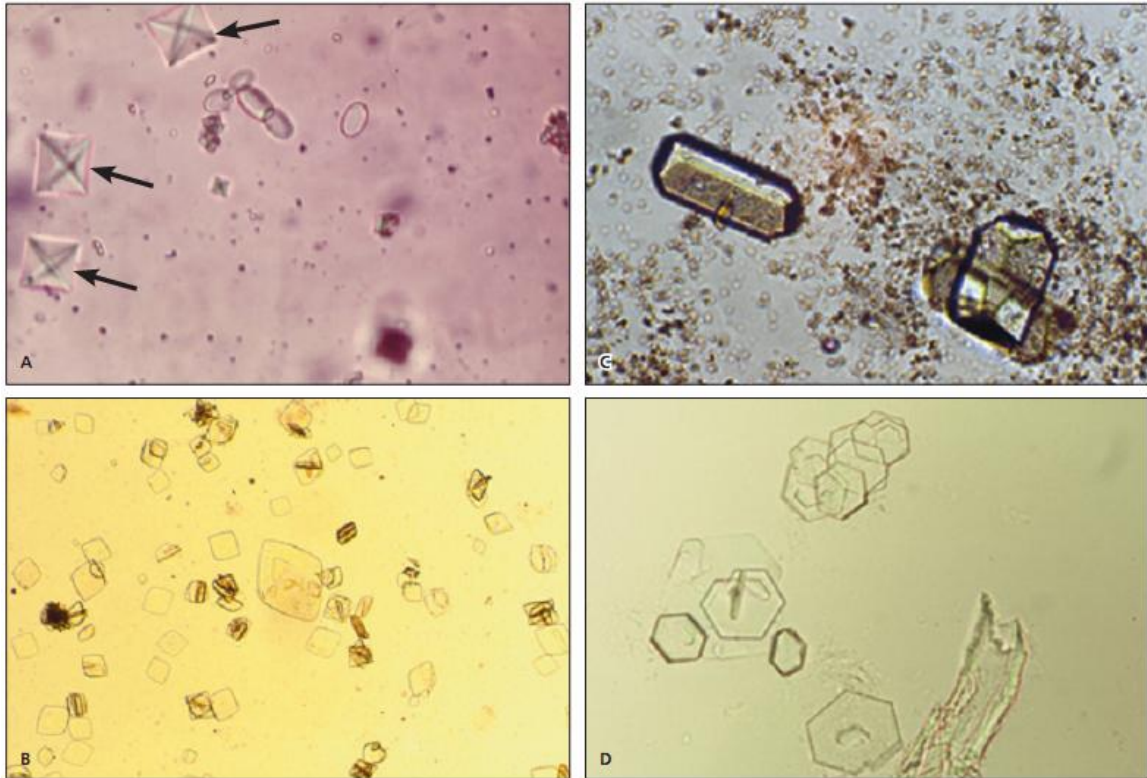
There is evidence that crystalluria, when repeatedly found urine samples, is highly predictive of the risk of nephrolithiasis. The most common types of kidney stones are composed of calcium oxalate crystals that represent 74.8% [12] - 80% [13] of cases; calcium apatite 10%. [12]; also about 5-10% of all stones are formed from uric acid [13]. Other Types of kidney stones are composed struvite (magnesium, ammonium and phosphate); which is known by other names like as infection stones, urease or triple-phosphate stones. It represents about 10-15% of urinary calculi [14]; and finally, cysteine represented 1% of renal stones [15].

In Basra City, southern of Iraq, there is a high prevalence of renal problems like urinary tract infections and Urolithiasis that

became common especially in the last few years; and when routine general urine examination is used, crystalluria is frequently found .In our work we try to

determine which predominant types of crystalluria and which gender, and age has higher incidence values.

Figure 1 Most common types of crystals appear under microscopes during urinalysis (A) calcium oxalate, (B) Amorphous urate & uric acid crystals, and (C) struvite crystals;



(D) cysteine crystals . ¹⁶¹

2. Subjects and Methods

328 patients of both gender and with different ages, performed general urine examination due to suspected renal problem like urinary tract infection .The urine samples were collected from different hospitals and private labs in Basra city; Southern of Iraq, in a period extended over four months from January to April 2010 . All 328 samples when examined under polarized optic microscope showed crystalluria, percentage of types of crystals found in urine was calculated and the data is

then analysed by excel 2007 using t-test and chi –analysis of frequency at $p < 0.05$.

The average age of patients, expressed as mean \pm standard deviation, was $[38.05 \pm 17.57]$, and age range extended from 1-80 years, number of males $[n=91]$ and with average age $[41.2 \pm 17.5 \text{ years}]$, while females patients $[n=237]$ with average age $[36.9 \pm 17.5 \text{ years}]$.

The purpose from our study is to find out which predominant types of crystalluria and which gender, and age have higher incidence values.

3. Results

Table 1 percentage of types of crystalluria

Types of crystalluria	No.	Percentage
Uric acid	315	96.03%
Calcium Oxalate	13	3.97% *

* Significant at $p < 0.05$ as compared with uric acid crystal

In study; for all 328 samples used; only two types of crystalluria are found which are uric acid that represented 96.03%

, and Calcium oxalate that represented 3.97 % as in table 1 .There was no cysteine, or struvite crystals.

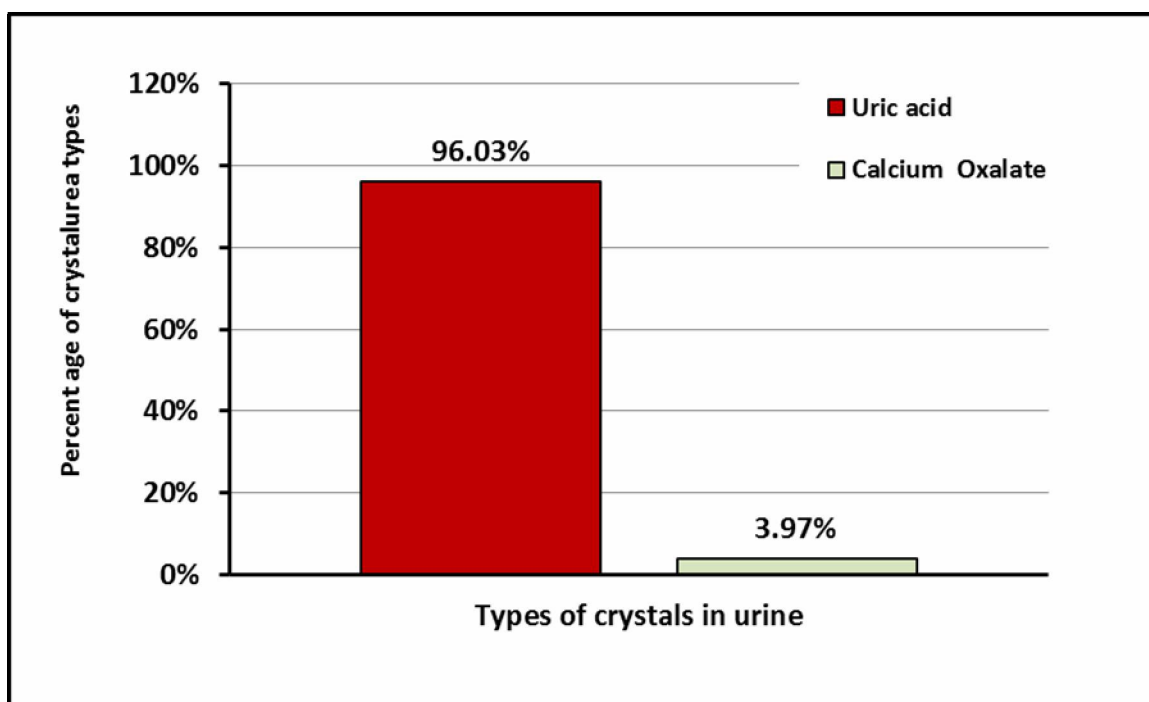


Figure 2 histogram shows percentage and types of crystals appeared in urine of patients involved in the study.

Table 2 Gender difference in the percentage of types of crystalluria

Gender	Total No.	Types of crystalluria			
		Uric acid		Calcium oxalate	
		No.	%	No.	%
Males	91	87	95.6%	4	4.4%
Females	237	228	96.2%	9	3.8%

Incidence percentage of uric acid crystals was greater in both genders (95.6% for males, 96.2% for females) as compared with the incidence percentage of calcium oxalate (4.4% for males and 3.8% for

females),(as in table 2) ,and there was no significant difference between males and females in incidence percentages for each type of crystalluria .See figure 3

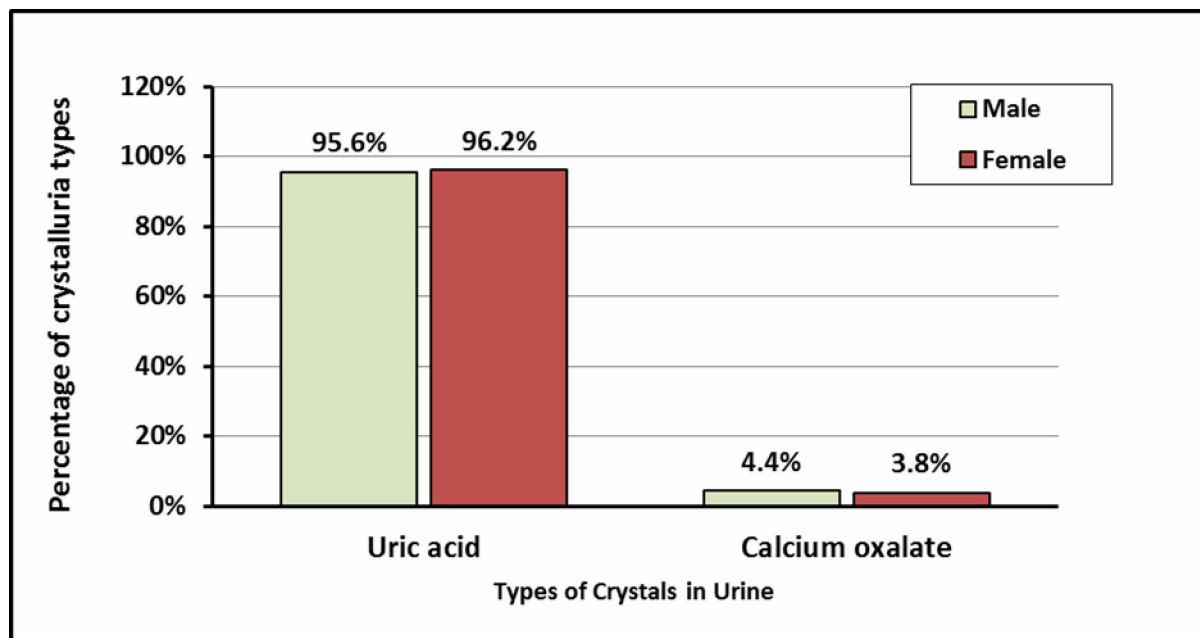


Figure 3 histogram shows gender differences in percentage of types of crystals appeared in urine of patients involved in the study

Table 3 Age differences in the percentage of types of Crystalluria

Age In years	Total No.	Types of Crystalluria			
		Uric acid		Calcium oxalate	
		No.	%	No.	%
≤9	9	8	88.9%	1	11.1%
10-19	38	37	97.4%	1	2.6%
20-29	78	75	96.2%	3	3.8%
30-39	55	53	96.4%	2	3.6%
40-49	53	51	96.2%	2	3.8%
50-59	40	38	95.0%	2	5.0%
≥60	55	53	96.4%	2	3.6%

In table 3; there were no significant differences (at $p < 0.05$) among all age groups in the incidence percentage of each type of crystalluria.

The incidence percentage of uric acid crystalluria was higher than oxalate crystalluria in all age groups; where it ranges from 88.9% in small children (0 – 9

years) and in the remaining age groups; the incidence percentage rounded to 96% except age group of 50-59years ,where the percentage was 95% .while incidence percentages for calcium oxalate were 11.1% for 0-9 years old group; and remaining groups rounded to 3.8% except age group of 10 -19years old; the percentage was 2.6%

and for 50-59 years old was 5% . See figure 4

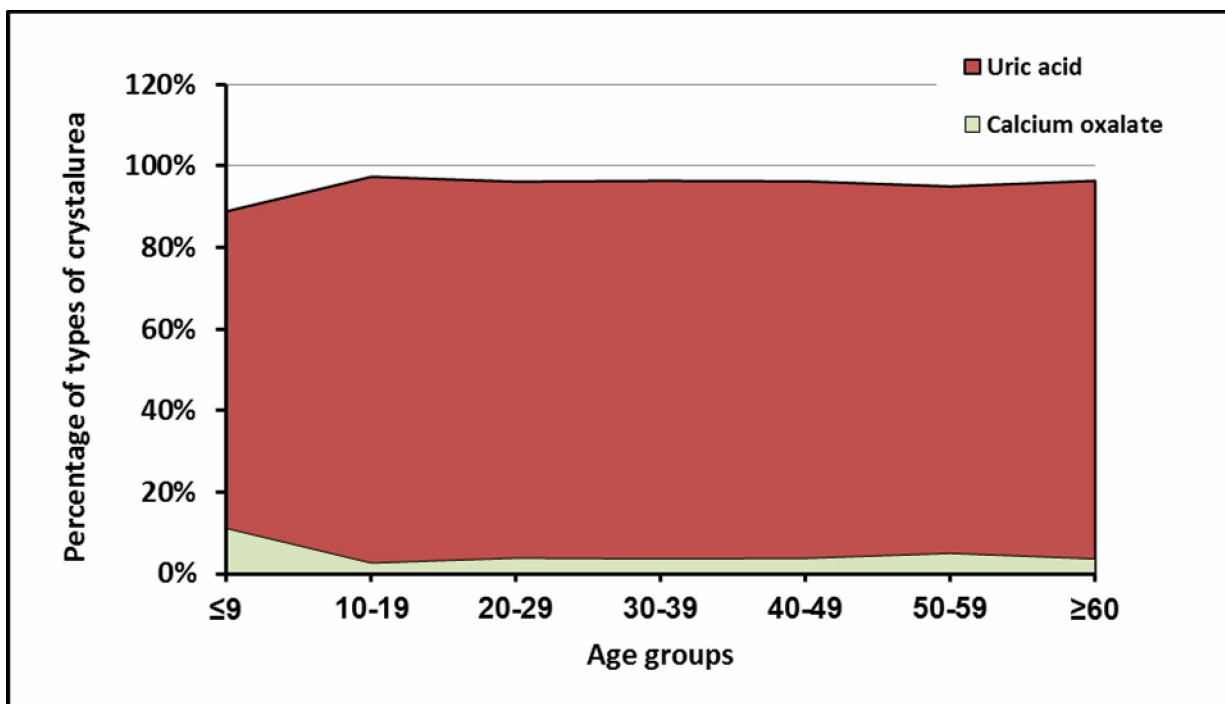


Figure 4 Figure shows age differences in incidence percentage of types of crystals appeared in urine of patients involved in the study.

4. Discussion

Crystalluria globally reflects the risk of stone formation as it integrates the complex interactions between promoters and inhibitors of lithogenesis. In clinical practice, finding of crystals in the urine sample should alert the physician that one or several urinary lithogenic factors determined by urine chemistry analysis are not adequately controlled. Such a finding suggests considering measuring of daily urine volume and urinary excretion of calcium, oxalate, uric acid, citrate, magnesium, urea, and sodium, in order to readjust dietary measures and institute or reinforce targeted drug therapy. In particular, finding of crystals in the first morning urine sample together with a high specific gravity highly suggests an excessive concentration of urine during the night, thus requiring increased fluid intake at bedtime. In addition, evidence of crystalluria contributes to motivate the patient to comply with medical recommendations. ^[17]

In Basra City; most cases of renal problems referred to the hospitals and clinics are associated with urinary tract

infection and crystal urea; in our study, we found that most crystal urea formed are uric acid is (96.03%); calcium oxalate (3.97%); but there were no other types of crystalluria found , as in table1.

Some studies showed that , more prevalent type of crystalluria is calcium oxalate and other calcium containing crystals like calcium phosphate crystals , and percentage of incidence of such crystalluria may reach to 70% ^{[18] [19] [4]}; and in other recent studies, the ratio is greater than that ^[20] , which in contrast with our finding. While the uric acid crystals showed, in our study, higher rate of incidence, as in table 1, which in contrast with other studies, where uric incidence was lower than in our study . ^{[18] [19] [4]}

The high incidence of uric acid crystalluria is possibly related to chemical properties of Uric acid; where it is a weak acid, with an ionization constant of acid (pK) of 5.8. At pH levels below the pK, uric acid is predominately found in a non ionized form. Uric acid crystals are formed when the

urinary pH is <5.5, where urine Ph is around 5.2 - 6.8 since it is less than pK of uric acid. Non ionized form of uric acid is slightly soluble or insoluble in the urine, so uric acid changes from a compound dissolved in solution to an insoluble precipitate lead to form uric acid crystals. [21]

Other factors may contribute to this higher ratio of uric acid crystal include: Dehydration that leads to reduce volume of urine which, in turn, may enhance precipitation of uric acid crystals; where low urine volume is very important factor that leads to the formation of uric crystalluria [22]. The consumption of low carbohydrate and high protein diet may lead to deliver a marked acid load to the kidney and increases the risk for crystallization [23]. Also changes in life style that occur in the last few years which led to excessive intake of purine – rich diet like: as liver, meat, kidney ,fish and seafood (uric acid is the final breakdown product of purine metabolism and is excreted in urine); and proteins found in animal products increase urinary excretion of uric acid [24].

Many factors may reduce the incidence of calcium oxalate crystalluria and stone like Seafood (fish) which is rich in Potassium, magnesium and vitamin B6 [25] which reduces urinary calcium excretion. Also Sun light and vitamin D have significant role in the reduction of calcium oxalate precipitation in kidneys [26].

Basra has a shiny summer, so we think this may contribute to the low incidence of calcium oxalate crystals in urine.

Other factor that have a role in decrease incidence of calcium crystal urea in

Basra is excessive intake of tea, several independent epidemiologic studies have shown that coffee and tea intake overall is protective against the of formation calcium containing stones. [27]

Water intake may influence crystals formation in urine, in one study, excessive water administration; resulted in reduction of crystallization of some crystals like calcium phosphate, but led to increase crystallization of struvite and uric acid dihydrate [28].

In table 2; there was no significant difference in the incidence of each crystalluria type between females and males, where the percentage (for uric acid crystalluria) was 95.6% for males and 96.2 % for females. And (for calcium oxalate) was 4.4% for males and 3.8% for females. This may differ from the prevalence ratio, where greater incidence of urate crystalluria was in males [29]. While calcium oxalate; the ratio of incidence for females to males in our study was nearly 1:1.16 which is much lower ratios than in some studies where it is known to occur more in males than females. [30][31][32]

Although some studies showed that crystalluria incidence has increased with age [32]. But in our study there were no significant differences among age groups for both types of crystalluria.

Conclusion Our finding there were only two types of crystalluria are most predominant ; those are uric acid and calcium oxalate and the incidence of uric acid crystalluria was significantly greater than oxalate in both genders and age groups, which may be greatly different from that reported in several studies outside country .

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البول البلوري (رمل الأدرار)، أنواعه السائدة ونسبة حدوثه في مدينة البصرة جنوبي العراق

جبران خليل حسن

ماجستير صيدلة سريرية

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الخلاصة

في مدينة البصرة، جنوبي العراق هنالك زيادة في عدد الحالات التي سببها مشكلات في الجهاز البولي والتي قد تعزى الى التهابات المجاري البولية المتكررة و البول البلوري او ما يطلق عليه ب(رمل الادرار). هدف الدراسة هو إيجاد نوع البول البلوري (رمل الادرار) السائد وتحديد الفترة العمرية وجنس المريض الذي لديه أعلى نسبة إصابة.

فقد تم جمع 328 عينة ادرار لـ 91 مريض و 237 مريضة لمختلف الأعمار، وقد تم فحص هذه العينات تحت المجهر لتحديد نوع البلورات في عينات الادرار. وكان معدل عمر المرضى (38±17,57) سنة و مدى الأعمار امتد من عدة ايام إلى 80 سنة وقد تم تقسيم الفئات العمرية إلى سبعة فئات تبدأ من (أقل من 9 سنة) وتمتد الى ما فوق ال 60 سنة، وقد تم التحليل الإحصائي باستخدام

(t -test and chi analysis of frequency at $p < 0.05$)

وكانت النتائج وجود نوعين فقط من البلورات السائدة والتي هي بلورات حامض البوليك (96,03%) و بلورات اوكزالات الكالسيوم (3,97%) ولم يوجد إي اختلاف معنوي بين جنسي المرضى لكل نوع من البلورات وكذلك لم يوجد اختلاف معنوي بين الفئات العمرية للمرضى حيث كانت البلورات حامض البوليك هي السائدة. **مفتاح الكلمات:** البول البلوري، رمل الأدرار، بلورات حامض البوليك، بلورات اوكزالات الكالسيوم