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STUDY OF URINARY STONES IN SYRIAN COAST (COMPOSITION AND ETIOLOGY)

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ABSTRACT

Background: Urinary stones are a common disease especially in civil societies. The rate of stone formation during a person life is estimated between 1-15%. Our country is located in the stone belt area, which is a geographical region characterized by high rates of stone formation among its population. It includes: Middle East, North Africa, and South Asia. **Objective:** Determining the prevalence of all types urinary stones in Syrian, and studying the causes of occurrence and recurrence. **Materials and Methods:** A prospective study of urinary stone patients in Syrian coast during 2022 and 2023. A chemical analysis was performed on stones isolated from the patients. They were 985 patients. **Results:** The study included 985 patients who had urinary stones: 614 male patients and 371 female patients. The most common complaint among patients at diagnosis was flank pain at a rate of 69.5%. urinary tract abnormalities causing stone formation were diagnosed in 7.9% of patients. The most common type of stones was pure calcium oxalate stones at a rate of 29.8%. The presence of a single or multiple metabolic disorder was recorded in 59.3% of patients. The most common metabolic disorder was hypercalciuria at a rate of 45.8%, followed by hypocitraturia at a rate of 38.7%. There was significant association between increased BMI and increased formation of uric acid stones and mixed stones (calcium oxalate + uric acid). There is an important relationship between stone recurrence and the presence of important metabolic disorders (hypocitraturia, hyperoxaluria, hyperuricosuria and decreased urine volume). **Conclusion:** It is recommended to analyze the components of urinary stones to determine the chemical composition, and apply adequate metabolic study for patients to determine the cause of stone formation, especially in patients with recurrent stones to prevent recurrence, which reflects a better quality of life for the patient and reduces treatment costs, especially in the stone belt area.

KEYWORDS: Urinary stones, Stones analysis, Stones recurrence, Syrian coast.

INTRODUCTION

Urolithiasis is one of the most widespread diseases worldwide, and high rates of urolithiasis have been observed, especially in developed urban communities. In the past, surgical treatment was the primary solution for extracting urinary stones. However, significant scientific advancements in medicine, and less invasive diagnostic and therapeutic techniques have greatly eased the challenges associated with surgical treatment and its complications.[1]

The treatment of urolithiasis patients requires significant expenses distributed among various diagnostic procedures and treatments of all kinds. Many cases of recurrence have been recorded among urolithiasis patients, leading to an increased focus on comprehensive patient assessment and the development of multiple treatment and prevention plans. This current scenario necessitates a thorough study of urinary stone disease regarding its causes, epidemiology, and pathological mechanisms.[2]

1-15% of the global population suffer from urinary tract stones at least once during their lifetime. This percentage varies based on factors such as gender, ethnicity, and geographical region. Notably, there is a clear prevalence of stones in regions such as the Middle East, South Asia, and North Africa, collectively known as the "Stone Belt".[3]

There are predisposing factors for the formation of urinary stones, especially when diagnosed at young ages or in the presence of accompanying metabolic diseases such as gout, hyperparathyroidism, renal tubular acidosis, and malabsorption syndromes. Genetic factors like primary hyperoxaluria and anatomical disorders in the urinary tract can also contribute to the formation of urinary stones.[4,5]

Urinary stones are classified based on their mineral content as follows.

Calcium-containing stones: Calcium oxalate stones, hydroxyapatite stones, Brushite stones.

Non-calcium stones: Uric acid stones, Struvite stones, Cystine stones, Drug-induced stones.[6]

Additionally, stones can be classified based on the proportions of their constituents.

- Pure stones: The primary component constitutes 80-100% of the stone composition.
- Mixed stones: The primary component constitutes less than 80% of the stone composition with the presence of other components.[7]

PATIENTS AND METHODS

Study population

The study included adult patients (over 18 years old) with urinary stones who visited Tishreen University Hospital in Lattakia and Al-Bassel Hospital in Tartous between March 2022 and March 2024. The extracted stones from the patients were analyzed. Patients with urinary stones who passed the stones without analysis, patients who did not follow up within the study for laboratory and radiological investigations, and patients under 18 years old were excluded. The patients with urinary stones who visited the study center were followed up, and after stone extraction, a chemical analysis was performed.[8.9] using chemical reagents from Medichem Middle East, a company licensed by the company in Germany.[10]

Following the determination of stone components through chemical analysis and after providing patients with information about the research method and obtaining their informed written consent to participate in the study, a specific form was organized for each patient containing.

1- Patient information: age, gender, occupation, body mass index, comorbidities, medical history, and the main complaint.

2- Stone information: number, location, stone history, and method of stone extraction (spontaneous passage, medical treatment, minimally invasive intervention, or invasive intervention).

3- Laboratory investigations: urine analysis, 24-hour urine collection, study of calcium, magnesium, phosphorus, citrate, oxalate, kidney function, and serum PTH levels as needed.

4- Radiological investigations: ultrasound, plain X-ray, CT scan, Contrast imaging, and renal Scintigraphy.

5- Patient follow-up results to determine the presence of stone recurrence and study the patient's stone history.

Statistical analysis

The statistical analysis was conducted utilizing IBM SPSS version 20. The basic descriptive statistics included means, standard deviations (SD), medians, frequencies, and percentages. To assess the differences between paired groups, the Friedman test was employed. All tests held significance at a type I error rate of 5% ($p<0.05$), with $\beta=20\%$, and 80% power for this study.

RESULTS

The research sample included 985 patients. The age of the patients ranged from 18 to 73 years, and the study included 350 males and 224 females.

Table 1: Distribution of study patients by gender and age.

	N	M	F	P value	Minimum age	Higher age	Average age
Adult group	985	614	371	0.4	18 year	68 year	37.5 year

According to Table 1, the ratio of male to female is 1.65: 1, with a P-value greater than 0.05, this means that sex has no statistically significant significance in the formation of urinary stones.

The main complaint that the study patients were referred to for the first time, whether in the clinic or the emergency department, varied, as the following table shows.

Table 2: Distribution of study patients by main complaint.

The main complaint	N	Percentage %
Flank pain	685	69.5%
Urinary Tract Infection (UTI)	90	9.1%
Urine discoloration/hematuria	115	11.7%
Low Urinary Tract Symptoms (LUTS)	41	4.2%
Oliguria	21	2.2%
Asymptomatic	33	3.3%
Total	985	100%

We note from the previous (Table 2) that flank pain is the most frequent complaint, and there have been cases of urinary oliguria due to stones in a patient with a single functional kidney or due to bilateral stones, and there are some cases discovered by chance as part of a routine investigation or for another complaint.

KUB plain radiographs and ultrasonography were performed for all study patients, and some other investigations were performed as needed, as the following table shows.

Table 3: Distribution of radiological investigations performed on study patients.

Radiological investigations	N	Percentage %
kidney, ureter, and bladder X-ray (KUB)	985	100%
ultrasonography	985	100%
intravenous pyelogram (IVP)	240	24.4%
Computed Tomography (CT)	312	31.7%
Renal Scintigraphy	61	6.2%

The result of radiological investigations was the diagnosis of the presence of abnormalities in the urinary tract that predispose to the formation of stones at a rate of 7.9% of the total study patients, the most frequent of which was the presence of a defect in the ureteropelvic junction (narrowing or high attachment of the ureter to the pelvis).

Table 4: Urinary abnormalities associated with stone formation.

Urinary abnormality	N	Percentage %
Malformation of the ureteropelvic junction	36	3.6%
Ureteral stricture	22	2.2%
Horseshoe Kidney	6	0.6%
renal malrotation	4	0.4%
Ureterocele	1	0.1%
Calyceal Diverticulum	9	0.9%
Total	78	7.9%

As for the distribution of patients according to the method of removing stones from the urinary tract.

The following (Table 5) shows the distribution of stones according to the method of stone extraction from patients, whether by spontaneous excretion, drug treatment, or surgical treatment.

Table 5: Distribution of patients according to the method of extracorporeal stone extraction.

Method of stone extraction	Number of stones	Percentage %
Surgical extraction of a kidney stone	142	14.5%
Percutaneous Nephrolithotomy (PNCL)	8	0.8%
Extracorporeal shock wave lithotripsy (ESWL)	205	20.8%
Surgical extraction of a ureteral stone	88	8.9%
Ureteral stone fragmentation by the retrograde route	184	18.6%
Drug Treatment	256	26%
Spontaneous Excretion	102	10.4%
Total	985	100%

As the previous (Table 5), we found that the largest percentage of stones were extracted with drug treatment and then with the method of extracorporeal shock wave lithotripsy (ESWL). This is due to the size of the stone causing the symptoms. When the size of the stone increases or when there are accompanying anatomical obstacles, we resort to minimally invasive and invasive methods.

The patients were divided into two main groups: the pure stone group, which included 556 patients, and the mixed stones group, which included 429 patients.

Table 6: Distribution of patients according to the chemical composition of the stones.

Chemical composition of stones	N	Percentage %
Pure stones	**556**	**56.5%**
Calcium oxalate	294	29.8%
Calcium phosphate (Carbonate Apatite)	47	4.8%
Uric acid	83	8.4%
Ammonium urate	53	5.4%
Struvite	35	3.6%
Cystine	44	4.5%
Complex stones	**429**	**43.5%**
Calcium oxalate + Carbonate apatite	178	18.1%
Calcium oxalate + Uric acid	112	11.3%

Calcium oxalate + Ammonium urate	89	9%
Calcium oxalate + Cystine	50	5.1%
Total	985	100%

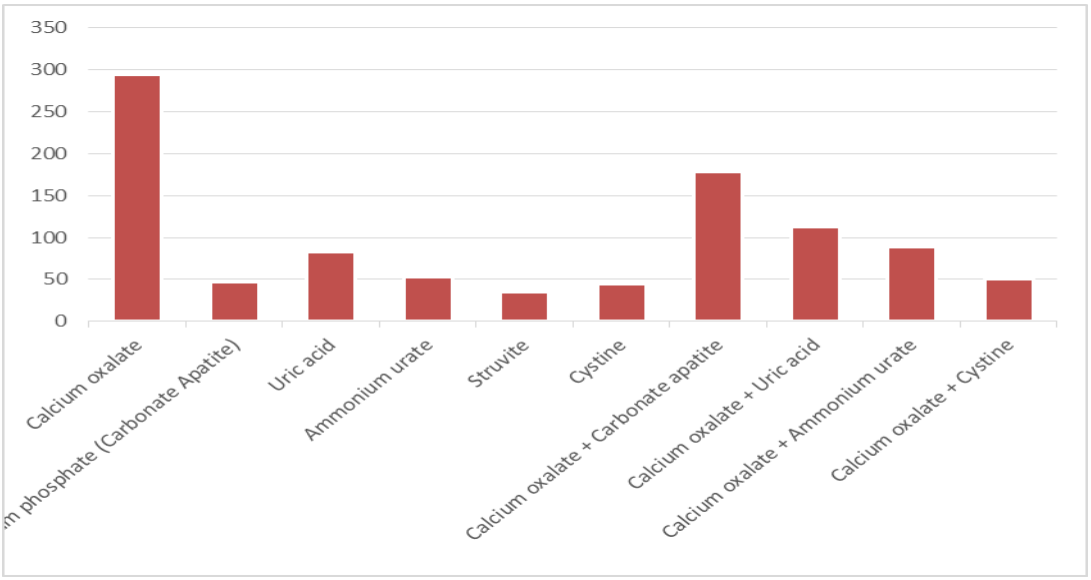

Figure 1: Distribution of patients according to the chemical composition of stones.

As for metabolic disorders in the research sample, 584 patients with a metabolic disorder were recorded, at a rate of 59.3%. Among these patients, 351 patients had a single metabolic disorder, at a rate of 60.1%, and 233 patients had several metabolic disorders (two or more), at a rate of 39.9%. The cases were distributed as follows.

Table 7: Distribution of patients according to the type of urinary metabolic disorder.

Urine metabolic disorder	Number of patients	Percentage %
Hypercalciuria	451	45.8%
Hyperoxaluria	159	16.1%
Hypocitraturia	381	38.7%
Hypomagnesiuria	83	8.4%
Hyperuricosuria	201	20.4%
Hyperphosphaturia	29	2.9%
Decreased urine volume < 1 L/24 h	264	26.8%

We note from the previous (Table 7) that the most frequent disorder is hypercalciuria, at a rate of 45.8%, followed by hypocitrate at a rate of 38.7%.

Studying the effect of the patient's weight on the distribution of the chemical composition of stones.

BMI body mass index was calculated according to the following equation: **BMI= (KG weight)/(Height squared m²)**

The study patients were divided into three groups by weight and the study distributed the chemical composition of stones by these groups, the result was as follows.

Table 8: Distribution of patients according to the type of urinary metabolic disorder.

Chemical composition of stones	Normal BMI<25	increase weight 25-29.9	Obesity BMI≥30	Total	P Value
Calcium oxalate	33	185	76	294	0.22
Calcium phosphate (Carbonate Apatite)	19	17	11	47	0.6
Uric acid	13	28	42	83	0.03
Ammonium urate	18	19	16	53	0.5
Struvite	11	15	9	35	0.6
Cystine	15	17	12	44	0.5
Calcium oxalate + Carbonate apatite	70	67	41	178	0.6
Calcium oxalate + Uric acid	11	36	65	112	0.04

Calcium oxalate + Ammonium urate	39	19	31	89	0.6
Calcium oxalate + Cystine	22	12	16	50	0.4
Total	251	415	319	985	

The analysis revealed a statistically significant association between weight gain and the formation of pure uric acid stones and mixed stones (calcium oxalate + uric acid). This finding aligns with the data presented in Table 8, which demonstrates an increased prevalence of these stone types with weight gain.

The formation of uric acid stones in overweight individuals is likely attributed to factors such as dietary patterns, metabolic syndrome leading to lower urine pH, and the deposition of calcium oxalate crystals on existing uric acid stones. In contrast, no significant association was found between weight gain and the formation of other stone types.

Patients were categorized into two groups based on their stone recurrence.
Group 1: Patients without a previous history of stones (n=524)
Group 2: Patients with at least one previous stone episode (stone recurrence group) (n=461)

After examining the relationship between stone recurrence and accompanying metabolic disorders, the following findings emerged.

Table 9: The relationship between urinary metabolic disorders and stone recurrence.

Urine metabolic disorder	Diagnosis of a stone for the first time N=524	Recurrent stone N=461	Total	P Value
Hypercalciuria	246	205	451	0.21
Hyperoxaluria	62	97	159	0.02
Hypocitraturia	130	251	381	0.006
Hypomagnesiuria	61	22	83	0.7
Hyperuricosuria	76	125	201	0.01
Hyperphosphaturia	16	13	29	0.7
Decreased urine volume	90	174	264	0.01

The previous (Table 9) highlights a significant increase in stone recurrence rates among patients with certain metabolic disorders. The P Value was less than 0.05, indicating a statistically significant association in this group of patients. The disorders associated with increased recurrence include.

Hyperoxaluria: Predisposes pure and mixed calcium oxalate stones, as oxalate is a primary component of these stones.

Hypocitraturia: Predisposes to calcium oxalate stones, as well as uric acid stones, since low citrate levels can lead to decreased urine pH.

Hyperuricosuria: Predisposes to uric acid stones and mixed calcium oxalate stones containing uric acid.

Low 24-hour urine volume: Increases the concentration of stone-forming components in the urine.

DISCUSSION

This study included 985 patients who visited the study center between March 2022 and March 2024 and were over 18 years old. The study extracted data from them and showed the following.

There was no statistically significant difference between males and females in the formation of calcium oxalate stones. The ratio of males to females was 1.65:1.

Flank pain was the most common complaint among the study patients, and medical treatment was the most commonly used method in managing stones formed in the urinary tract of the study patients.

Anatomical abnormalities were only diagnosed in 7.9% of the study patients, indicating that most of these abnormalities are usually congenital and diagnosed and managed in childhood.

Pure calcium oxalate stones were the most commonly diagnosed type in the study at 29.8%, with several mixed types containing calcium oxalate and other chemical compounds also identified.

Metabolic disturbances were observed in only 59.3% of the study patients after a 24-hour urine analysis, suggesting that the formation of urinary stones does not necessarily require an accompanying metabolic disorder. The most common metabolic disorder was hypercalciuria at 45.8%, followed by hypocitraturia at 38.7%.

There was a clear impact of decreased 24-hour urine volume on stone formation, observed in 26.8% of the patients.

An increase in the formation of uric acid stones and mixed calcium oxalate stones with uric acid was noted with increasing body mass index, possibly related to

dietary patterns high in protein and subsequent crystal deposition.

In discussing this study in the context of existing literature, it is necessary to explore how these findings correlate with or diverge from other significant research in the field of urology about to urinary stones.

The first study by Wang et al. (2021) focuses on the risk factors of urinary stones by evaluating the association between stone composition and urine components. The study involved 223 patients with stones and healthy controls, analyzing the components of the stones and urine collected before surgery to understand the risk factors for the recurrence of urolithiasis. It highlighted the importance of assessing the relationship between stone composition and urine components to identify risks associated with urolithiasis.[11]

The second study by Wrobel et al. (2012) explores the connection between overweight and obesity as potential risk factors in calcium oxalate stone disease. Investigating the impact of body weight on the formation of kidney stones, this study delves into how being overweight or obese may increase the likelihood of developing calcium oxalate stones.[12]

Lastly, Khan et al. (2018) conducted a study on Fourier transform infrared spectroscopy for the analysis of kidney stones. This study demonstrates the utility of FT-IR analysis in identifying the crystal types present in kidney stones, providing valuable insights for clinicians in understanding the composition of urinary stones.[13]

CONCLUSION

This study of 985 patients with urinary tract stones revealed that calcium oxalate stones were the most common type, but metabolic disturbances were not always present. Hypercalciuria and hypocitraturia were the most prevalent metabolic factors, and decreased 24-hour urine volume was significantly associated with stone formation. Increased BMI was linked to uric acid stones, suggesting a potential dietary connection. These findings underscore the need for individualized treatment and prevention strategies addressing both metabolic and lifestyle factors.

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