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Original Research Article

Compositions of Urinary Stones in Iraqi Patients and Their relations with Different Regions and Ethnicities

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Abstract

In order to know the chemical composition of urinary stones in Iraqi patients, and if there were any correlation between stone types and different Iraqi regions and ethnicities.

In the period from February 2014 to November 2016, a total of 3130 stone samples were collected from different Iraqi provinces, via different stone management procedures. Demographic data were also requested with each stone sample including; patient's age, gender, residence, ethnicity, site and way of stone removal. Then all samples were subjected to physical analysis to detect their composition using Fourier Transform Infrared Spectroscopy (FTIR) technique. Data were divided into 3 categories (total: 3130 samples, upper urinary tract stones: 2588 samples, and lower urinary tract stones: 542 samples).

The overall mean age was 38.4 ±16.1 years, and overall male to female ratio 2.16:1. The most common stone types in overall study was Calcium oxalate stone (46%), followed by Uric acid stone (20.4%), Mixed stones (16.5%), Phosphate stone (10.4%), Cystine stone (3.7%), Matrix stone (2%) and other rare types (1%). There is a statistically reliable relationship between stone types and different Iraqi regions and ethnicities, with Calcium oxalate stone as more prevalent in Kurdish patients and north regions while Uric acid stone was more prevalent in Arab patients and middle regions. Also Calcium oxalate and uric acid stones were more prevalent in elderly patients, while cystine stones in those who are < 20 years old.

Key Words: Stone composition, Stone analysis, Iraqi urinary stones, Infrared Spectroscopy.

مكونات حصى الجهاز البولي للمرضى العراقيين وارتباطها بمختلف المناطق والقوميات

الخلاصة

من اجل معرفة المكونات الكيميائية لحصى المسالك البولية للمرضى العراقيين وهل هناك اختلاف في انواع الحصى مع اختلاف قوميات واماكن سكن المرضى.

تم جمع ٣١٣٠ عينة من حصى المسالك البولية من مختلف محافظات العراق وأخذت ايضا معلومات المريض المصاب بالحصى من حيث العمر، الجنس، السكن، القومية، مصدر وطريقة الحصول على الحصى، ومن ثم تم اخضاع جميع العينات للفحص الفيزيائي بواسطة الاشعة تحت الحمراء بتقنية فورير لتحديد مكوناتها الاساسية. كان معدل عمر المرضى المشمولين بالدراسة (٣٨,٤±١٦,١) سنة، مع نسبة الذكور الى الاناث ٢,١٦ الى ١.

و قد شكلت حصاة اوكزالات الكالسيوم ٤٦% من مجموع الحصى في عموم العراق وحصاة حامض البوليك (اليورك) ٢٠,٤% والحصى المختلط ١٦,٥ % وحصى الفوسفات ١٠,٤% وحصاة السستين ٣,٧%، وقد لوحظ تباين في انواع الحصى بين مختلف قوميات ومناطق العراق .

ان الحصى المحتوية على الكالسيوم تمثل النسبة الاعلى من حصى المسالك البولية في العراق و خاصة حصاة اوكزلات الكاليسوم وبنسبة عالية في المرضى الاكراد وفي المناطق الشمالية. بينما احتلت حصاة حامض البوليك (اليورك) المرتبة الثانية وبنسبة عالية في المرضى العرب وفي المناطق الوسطى من العراق. وكانت نسبة حصى اوكزلات الكالسيوم وحامض البوليك عالية في المرضى كبار السن بينما حصاة السستين كانت بنسبة عالية في المرضى اقل من ٢٠ سنة.

Introduction

Urolithiasis is a common and a major cause of morbidity worldwide. The distribution of urolithiasis varies differently across the world. The life time prevalence of renal stone disease was estimated at 1% to 15%. There was geographical variability of Urolithiasis with higher prevalence of stone formation in areas of hot Climate, decreased fluid intake, increased perspiration, and increased urinary concentration would predispose to increased crystallization and stone formation. Beside climatic condition, there were other factors predispose to stone formation such as genetic factors, dietary habit, water hardiness, gender, age, occupation and body weight [1].

Different urinary stones and their crystalline components are summarized in table [1] [2].

Table 1: Crystalline Components of Urinary Stones.

Component	Formula	Mineralogical name
Calcium oxalate monohydrate	CaC2O4.H2O	Whewellite
Calcium oxalate dehydrate	CaC2O4.2H2O	Weddellite
Magnesium ammonium phosphate hexahydrate	MgNH4PO4.6H2O	Struvite
Magnesium ammonium phosphate monohydrate	MgNH4PO4.H2O	Dittmarite
Calcium hydrogen phosphate dehydrate	CaHPO4.2H2O	Brushite
Carbonate-apatite	Ca10 (PO4 CO3) 6(OH) 8	Carbonate –apatite
Hydroxyl-apatite	Ca10 (PO4) 6(OH) 2	Hydroxyl-apatite
Anhydrous tricalcium phosphate	Ca3 (PO4) 2	Whitlockite
Magnesium dibasic phosphate trihydrate	MgHPO4.3H2O	Newberyite
Uric acid	C5H4N4O3	Uric acid
Uric acid dehydrate	C5H4N4O3.2H2O	Uric acid dehydrate
Sodium acid urate	NaC5H3N4O3.H2O	Sodium acid urate
Ammonium acid urate	NH4C5H3N4O3.H2O	Ammonium acid urate
Cystine	C6H12N2O4S2	Cystine
Xanthine	C5H4N4O2	Xanthine

After stone passage, every patient should be assigned to reliable stone analysis by infrared spectroscopy or x-ray diffraction. Stone type is the deciding factor for further diagnostic tests [3].

Analysis of urinary stone is an important requirement for successful management of the disease, which implies not only a proper evaluation and treatment, but also prophylaxis to prevent recurrence [4].

Infrared spectroscopy was used firstly in 1955 [5]. However, it has become as a popular reliable method for *in vitro* quantitative stone analysis in the last decade [6]. European Association of Urology Guidelines 2013 on urolithiasis underlines the obsolescence of chemical analysis and recommends the use of Fourier Transform Infrared Spectroscopy (FTIR) for urinary stone analysis.

The aim of this study was to investigate the chemical composition of urinary stones in Iraqi patients, and if there were any statistical correlation between stone types and different Iraqi regions and ethnicities.

Materials and Materials:

In this cross sectional study, which was conducted at Urology Department of Al-Sadr Medical City in Al-Najaf Province, Iraq in the period from February 2014 to November 2016; a total of 3130 stone samples were collected from different Iraqi provinces through different stone management procedures. Demographic data were also requested from patients including: age, gender, residence, ethnicity, stone collection technique, whether spontaneous passage or surgically removed, and the site of stone whether from upper or lower urinary tracts. Then all stone samples were subjected to physical analysis by FTIR spectroscopy.

Results

In this cross sectional study, the results were divided into three categories; Total: 3130 stone samples, Upper urinary tract stone samples: 2588, and Lower urinary tract stone samples: 542.

Category one (total 3130 stone samples):

A total of 3130 stone samples collected from different Iraqi provinces were divided into three regions, north= 259 (8.3%), middle= 2097 (67%) and south =774 (24.7%), as shown in table (2) and figure (1).

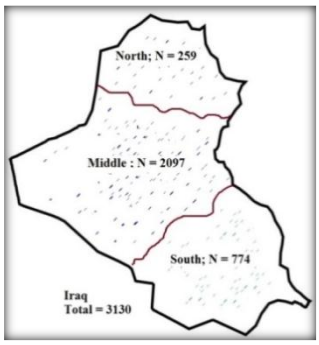

Figure 1: Distribution of study population according to the Iraqi Regions.
North provinces: Erbil, Duhok, Sulaimaniya, Nineva;
Middle provinces: Baghdad, Babil, Najaf, Karbala, Diwaniya, Anbar, Kut;
South provinces: Basrah, Samawa, Nasriya, Messan.

Table 2: Distribution of study population according to the Provinces of residence

Province	Frequency	Percent
Najaf	1375	43.9
Baghdad	276	8.8
Diwaniya	235	7.5
Nasriya	219	7
Karbala	193	6.2
Nineva	192	6.1
Samawa	181	5.8
Babil	162	5.2
Basrah	126	4
Kut	69	2.2
Duhok	32	1
Anbar	22	0.7
Sulaimaniya	20	0.6
Erbil	15	0.5
Messan	13	0.4

Total	3130	100

In this study, patients' age ranges from 1 to 90 years, with mean age ± SD = 38.4±16.1 years. Patients were divided into four age groups: <20 years= 251(8%), 20-39 years=1503 (48%), 40-59 years=988 (31.6%) and ≥ 60 years=388 (12.4%). The age group of 20-39 years was highly affected by stone disease (48%), while <20 years was least likely to be affected (only 8%), as shown in table (3).

Males constitute 2141 (68.4%), while females 989(31.6%), and male to female ratio 2.16:1, as shown in table (3).

Patients were divided into Arab 2897 (91.6%) and non- Arab 263 (8.4%); including Turkmen 148 (4.7%), Shabak 48 (1.5%), Kurdish 57(1.8%) and Yazidis 10 (0.4%), as shown in table (3).

Table 3: Descriptive characteristics of patients with urinary stones in total stone samples .

Variable		No.	%
Age (year)	< 20	251	8.0
	20 – 39	1503	48.0
	40 – 59	988	31.6
	≥ 60	388	12.4
	Total	3130	100.0
Gender	Male	2141	68.4
	Female	989	31.6
	Total	3130	100.0
Region	South	774	24.7
	Middle	2097	67
	North	259	8.3
	Total	3130	100.0
Ethnicity	Arab	2867	91.6
	Non-Arab	263	8.4
	Turkmen	148	4.7
	Shabak	48	1.5
	Kurdish	57	1.8
	Yazidis	10	0.4
Total		3130	100.0

Site & Way of Stones Removal:

Stone sites were divided into upper urinary tract (Kidney and Ureter) stones 2588 (82.7%), and lower urinary tract (Bladder) stones 542 (17.3%). Open surgical retrieval of stones was done in 741cases (23.7%), while endoscopic retrieval in 1396 (44.6%), and spontaneous passage in 993 (31.7%), as shown in table (4).

Table 4: Site of urinary stones and way of stones removal in total samples.

Site of stone	No.	%
Upper	2588	82.7
Lower	542	17.3
Total	3130	100.0
Way of stone removal		
Open Surgical removal	741	23.7
Endoscopic	1396	44.6
Spontaneous	993	31.7
Total	3130	100.0

Stone Analysis For Total Stone Samples:
The results of stone analysis by FTIR of a total 3130 stone samples show higher percent of Calcium oxalate stones 46% (COM 31.1%, COD 14.9%), followed by Uric acid stone 20.4% and Mixed stones 16.5%, and other stone types in decreased frequency, as shown in table (5).

Table 5: Results of Urinary Stones Analysis For Total Stone Samples

Stone types		No.	%
Calcium oxalate		1439	46.0
COM		972	31.1
COD		467	14.9
Uric acid		639	20.4
Mixed		15	5.5
	COM + AU	226	7.2
	COM+COD	130	4.2
	Ca Ph.+ Struvite	95	3.0
	AU + Cap.	64	2.1
Phosphate		326	10.4
	Struvite	171	5.4
	Carbonate apatite	155	5.0
Cystine		115	3.7
Matrix		63	2.0
Others*		33	1.0

**Others: (Brushite 20, Calcite 6 , silicate 4,Triamteren 3)*

Relationship Between Stone Types & Ethnicities
Although Calcium oxalate stone was highly frequent in overall Iraqi ethnicities, it was statistically significant (63.2%) in only Kurdish patients **(P value 0.048)**, while Uric acid stone was more frequent in Arab and Turkmen than other ethnicities, and was only statistically significant (20.9%) in Arab patients **(P value 0.035)**. Other types of stones encountered in different Iraqi ethnicities did not have significant statistical correlation, as shown in table (6).

Table 6: Relationship between stone types and ethnicities in total stone samples

Stone type	Arab		Turkmen		Shabak		Kurdish		Yazidis		Total	P
	No.	%	No.	%	No.	%	No.	%	No.	%		
Calcium oxalate	**1300**	45.3	**71**	48.0	**27**	56.3	**36**	63.2	**5**	50.0	**1439**	**0.048**
Uric acid	**599**	20.9	**30**	20.3	**5**	10.4	**4**	7.0	**1**	10.0	**639**	**0.035**
Mixed	**480**	16.7	**19**	12.8	**7**	14.6	**6**	10.5	**3**	30.0	**515**	0.34
Phosphate	**297**	10.4	**14**	9.5	**8**	16.7	**7**	12.3	**0**	0.0	**326**	0.47
Cystine	**102**	3.6	**7**	4.7	**1**	2.1	**4**	7.0	**1**	10.0	**115**	0.42
Matrix	**60**	2.1	**4**	2.7	**0**	0.0	**0**	0.0	**0**	0.0	**64**	0.59
Others	**29**	1.0	**3**	2.0	**0**	0.0	**0**	0.0	**0**	0.0	**32**	0.61
Total	**2867**	100.0	**148**	100.0	**48**	100.0	**57**	100.0	**10**	100	**3130**	

Relationship Between Stone Types and Regions of Residence:
In spite of higher percentage of Calcium oxalate stone in overall Iraqi regions, it was more frequent (53.3%) in north regions with statistical significance **(P value 0.032)**, while Uric acid stone was more frequent in south and middle regions and only statistically significant (21.5%) in middle regions **(P value 0.036)**. Other types of

stones encountered had no significant statistical correlation, as shown in table (7).

Table7: Relationship between stone types and regions of residence in total stone samples

Stone type	South		Middle		North		P
	No.	%	No.	%	No.	%	
Calcium oxalate	361	46.6	940	44.8	**138**	**53.3**	**0.032**
Uric acid	149	19.3	**451**	**21.5**	39	15.1	**0.036**
Mixed	123	15.9	358	17.1	34	13.1	0.23
Phosphate	86	11.1	212	10.1	28	10.8	0.39
Cystine	27	3.5	75	3.6	13	5.0	0.41
Matrix	20	2.6	40	1.9	4	1.5	0.40
Others	8	1.0	21	1.0	3	1.2	0.92
Total	774	100.0	2097	100.0	259	100	

Category 2: upper urinary tract stones 2588: The same descriptive parameters of category one were applied here; and the results are shown in table (8).

Table 8: Descriptive characteristics of patients with upper urinary tract stones

Variable		**No.**	**%**
Age (year)	< 20	221	8.5
	20 – 39	1501	58.0
	40 – 59	745	28.8
	≥ 60	121	4.7
	Total	2588	100.0
Gender	Male	1780	68.8
	Female	808	31.2
Region	South	626	24.2
	Middle	1729	66.8
	North	233	9.0
Ethnicity	Arab	2353	90.9
	Turkmen	132	5.1
	Shabak	41	1.6
	Kurdish	53	2.0
	Yazidis	9	0.4
Way of stone removal	Open surgical removal	567	21.9
	Endoscopic	1105	42.7
	Spontaneous	916	35.4

Results of Stone Analysis for Upper Urinary Tract Stone Samples:

The results of stone analysis in this category show higher percentage of Calcium oxalate stones (48,6%), followed by Uric acid stones (24.2%), Mixed stones (12.9%), and lower percentage for Phosphate stones (6.3%), Cystine stone (4.5 %), Matrix stone (2.4%) and other rare types (1.1%), as shown in table (9).

Table 9: Results of stones analysis for upper urinary tract stone samples

Stone types		No.	%
Calcium oxalate		1257	48.6%
	COM	870	33.6%
	COD	378	14.9%
Uric acid		625	24.2%
Mixed		335	12.9%
	COM+AU	226	8.7%
	COM+COD	109	4.2%
Phosphate		164	6.3%
	Carbonate apatite	114	4.4%
	Struvite	50	1.9%
Cystine		115	4.5%
Matrix		63	2.4%
Others		29	1.1%
Total		2588	100.0

Relationship Between Stone Types & Age Groups:

There were increased prevalence of Calcium oxalate stones in 40-59 years (52.3%) and uric acid stones in ≥ 60 years (35.5%), while Cystine stones in < 20 years (28.1%), all of them with significant statistical levels (P value 0.01, <0.001), while other types of stones encountered had no significant statistical relationship with age groups, as shown in table (10).

Table 10: Relationship between stone types and age groups in upper urinary tract stone samples

Stone type	**Age (year)**								**Total**	**P**
	< 20		**20 – 39**		**40 – 59**		**≥ 60**			
	No.	%	No.	%	No.	%	No.	%		
Calcium oxalate	93	42.1	725	48.3	390	52.3	49	40.5	1257	**0.01**
Urate	31	14.0	370	24.7	181	24.3	43	35.5	625	**< 0.001**
Mixed	19	8.6	205	13.7	91	12.2	20	16.5	335	0.11
Phosphate	13	5.9	99	6.6	47	6.3	5	4.1	164	0.74
Cystine	62	28.1	37	2.5	15	2.0	1	0.8	115	**< 0.001**
Matrix	3	1.4	46	3.1	13	1.7	1	0.8	63	0. 45
Others	0	0.0	19	1.3	8	1.1	2	1.7	29	0.37
Total	221	100.0	1501	100.0	745	100	121	100	2588	

Relationship between stone types & Iraqi ethnicities:

In spite of high percent of Calcium oxalate stones in Kurdish patients (64.2%), but it did not reach significant statistical level, while uric acid stone was more frequent (24.9%) in Arab patients with significant statistical level (P value 0.01). Other types of stones encountered had no significant statistical correlation, as shown in table (11).

Table 11: Relationship between stone types and Iraqi ethnicities in upper urinary tract stone samples

Stone type	Arab		Turkmen		Shabak		Kurdish		Yazidis		Total	P
	No.	%	No.	%	No.	%	No.	%	No.	%		
Calcium oxalate	1132	48.1	65	49.2	22	53.7	34	64.2	4	44.4	1257	0.21
Uric acid	**585**	**24.9**	30	22.7	5	12.2	4	7.5	1	11.1	625	0.01
Mixed	305	13.0	14	10.6	7	17.1	6	11.3	3	33.3	335	0.32
Phosphate	144	6.1	9	6.8	6	14.6	5	9.4	0	0.0	164	0.17
Cystine	102	4.3	7	5.3	1	2.4	4	7.5	1	11.1	115	0.58
Matrix	59	2.5	4	3.0	0	0.0	0	0.0	0	0.0	63	0.59
Others	26	1.1	3	2.3	0	0.0	0	0.0	0	0.0	29	0.6
Total	2353	100	132	100	41	100	53	100.0	9	100	2588	

Relationship Between Stone Types & Regions Of Residence:

Calcium oxalate stone was the commonest type in overall three Iraqi regions and without significant statistical difference, while uric acid stone was more frequent in south and middle regions and only statistically significant (25.4%) in middle regions (P value 0.01). Other types of stone had convergent results in overall three regions and without significant statistical differences, as shown in table (12).

Table 12: Relationship between stone types and regions of residence in upper urinary tract stone samples

Stone types	South		Middle		North		P
	No.	%	No.	%	No.	%	
Calcium oxalate	300	47.9	832	48.1	125	53.6	0.26
Uric acid	147	23.5	**439**	**25.4**	39	16.7	**0.01**
Mixed	81	12.9	225	13.0	29	12.4	0.97
Cystine	27	4.3	75	4.3	13	5.6	0.68
Phosphate	44	7.0	100	5.8	20	8.6	0.18
Matrix	19	3.0	40	2.4	4	1.7	0.49
Others	8	1.4	18	1.0	3	1.4	0.86
Total	626	100	1729	100	233	100	

Category 3: Lower Urinary Tract Stone Samples: 542:

In this category, the same parameters in category two were applied, except the age groups which divided into two groups ≤ 12 years and ≥ 40 years because there were no stone samples between 13-39 years, as shown in table (13).

Table 13: Descriptive characteristics of patients with lower urinary tract stones

Variable		No.	%
Age (year)	≤ 12	30	5.5
	≥ 40	512	94.5
	Total	542	100.0
Gender	Male	361	66.6%
	Female	181	33.4%
	Total	542	100.0
Region	South	148	27.3%
	Middle	368	67.9%
	North	26	4.8%
	Total	542	100.0
Ethnicity	Arab	514	94.8%
	Turkmen	16	3.0%
	Shabak	7	1.3%

	Kurdish	4	0.7%
	Yazidis	1	0.2%
	Total	542	100.0
Way of stone removal	Open surgical removal	174	32.1
	Endoscopic	291	53.7
	Spontaneous	77	14.2
	Total	542	100.0

Results of Stone Analysis For Lower UT Stone Samples:

The results of stone analysis in this category show higher percent of Calcium oxalate stone (33.6%), Mixed stones (33.2%), and Phosphate stone (29.9%), while lower percent for Uric acid stone (2.5%) and other rare types (0.8 %), as shown in table (14).

Table 14: Results of stones analysis for lower urinary tract stone samples.

Stone types	No.	%
Calcium oxalate	182	33.6
COM	102	18.8
COD	80	14.8
Mixed	180	33.2
COM +COD	21	3.8
Ca ph.+Struvite	95	17.5
AU+Cap.	64	11.8
Phosphate	162	29.9
Struvite	121	22.3
Carbonate apatite	41	7.6
Uric acid	14	2.5
Others	4	0.8

Relationship Between Stone Types & Age Groups:

There were more frequent Calcium oxalate stones (35.5%) in those patients ≥ 40 years old, and uric acid stone (40%) in those ≤ 12 years old, both of them with statistically significant p values (p<0.001).

Other stone types (mixed and phosphate stones) had no significant statistical correlation with age, as shown in table (15).

Table 15: Relationship between stone types and age groups in lower urinary tract stone samples

Stone type	**Age (year)**				**P**
	≤ 12		**≥ 40**		
	No.	%	No.	%	
Calcium oxalate	0	0.0	182	35.5	**< 0.001**
Uric acid	12	40.0	2	0.4	**< 0.001**
Mixed	9	30.0	171	33.4	0.85
Phosphate	9	30.0	153	29.9	0.84
Others	0	0.0	4	0.8	0.54
Total	30	100	512	100	

Relationship Between Stone Types & Iraqi Ethnicities:

Although Calcium oxalate stones were more frequent in Yazidis and Kurdish patients, but they had no statistical significance. Other types of stones had no significant statistical correlation, as show in table (16).

Table 16: Relationship between stone types and ethnicities in lower urinary tract stone samples

Stone types	Arab		Turkmen		Shabak		Kurdish		Yazidis		Total	P
	No.	%	No.	%	No.	%	No.	%	No.	%		
Calcium Oxalate	168	32.7	6	37.4	5	71.4	2	50.0	1	100	182	0.12
Uric acid	14	2.7	0	0.0	0	0.0	0	0.0	0	0.0	14	0.94
Mixed	175	34.0	5	31.3	0	0.0	0	0.0	0	0.0	180	0.19
Phosphate	153	29.8	5	31.3	2	28.6	2	50.0	0	0.0	162	0.87
Others	4	0.8	0	0.0	0	0.0	0	0.0	0	0.0	4	0.99
Total	514	100	16	100	7	100	4	100	1	100	542	

Relationship Between Stone Types & Regions of Residence:

There were more frequent Calcium oxalate stones in both south and north regions, but they were only statistically significant (50%) in north regions (P value 0.006), while mixed stones were more frequent in south and middle regions but only statistically significant (36.1%) in middle regions (P value 0.035), as shown in table (17).

Table 17: Relationship between stone types and regions of residence in lower urinary tract stone samples

Stone type	**South**		**Middle**		**North**		**P**
	No.	**%**	**No.**	**%**	**No.**	**%**	
Calcium oxalate	61	41.2	108	29.3	**13**	**50.0**	**0.006**
Uric acid	2	1.4	12	3.3	0	0.0	0.32
Mixed	42	28.4	**133**	**36.1**	5	19.2	**0.035**
Phosphate	42	28.4	112	30.4	8	30.8	0.89
Others	1	0.7	3	0.8	0	0.0	0.49
Total	148	100	368	100	26	100	

Discussion

Nephrolithiasis is a recurrent condition with considerable morbidity. While in symptomatic stone episodes the appropriate treatment is necessary, prophylactic workup to prevent recurrences is also of great importance, which is possible by a complete metabolic workup and a suitable stone analysis [6].

Identifying the crystalline form is very useful for planning therapy, for example COM stone associated with hyperoxaluria, while COD stone associated with hypercalciuria [7].

The age group of 20-39 years was mostly affected by stone disease in current study. Urolithiasis generally affects adult men more than women [8, 9].

In current study; the overall mean age was (38.4) years, in agreement with other Iraqi study by Ehab [10].

In comparison to the mean age in nearby countries, the mean age in Iran was 40.5years [11], in Oman was 41 years [12], while in Morocco 49 years [13].

Worldwide Stone occurrence is relatively uncommon before age of 20, the peak incidence found to be in the fourth to sixth decades of life [14].

The overall male to female ratio in current study was 2.16:1, which was similar to other Iraqi study by Khalis [15].

In Iran male to female ratio 2.7:1 [11], in Oman 3.7:1 [12], in Morocco 2.03:1[13], while in KSA male to female ratio was 5:1 [16].

Male gender had been affected by stone disease more than female, and this might be due to the high level of testosterone in male leading to increased productions of oxalate in the liver and predisposing to Calcium oxalate stone, also the protective effect of estrogen against stone formation in

premenopausal women by enhanced renal calcium absorption and reduced bone calcium resorption [17].

In current study, upper urinary stones constitute 82.7% and lower urinary stones 17.3%, in agreement with the result of Yasui et al [18].

In current study the Calcium oxalate stone was the commonest type in overall stone samples (46%), followed by Uric acid stone (20.4%), Mixed stones (16.5%), Phosphate stone (10.4%) then Cystine stone (3.7%), Matrix stone (2%), and other rare types (1%).

Calcium oxalate stone is one of the most common stone type worldwide, constitutes about 70% of all stone types especially in the Middle East [19].

Inside Iraq, Calcium oxalate stone was common and frequent in overall five nationalisms and three regions addressed in this study, but with significant prevalence in Kurdish patients and in north regions and this might be due to different epidemiological factors such as (dietary habit with high oxalate content, climate, water supply) socioeconomic and genetic factors between studied populations [20].

Second most common type of urinary stones in current study was Uric acid stone which was more prevalent in Arab patients and in south and middle regions and this might be due to different dietary habit rich in purine, like red meat, hot dry climate in these regions in comparison to north regions, in addition to socioeconomic and genetic factors [21].

In current study, there were variable results of urinary stone analysis according to the site of stone, whether from upper or lower urinary tracts in relations with age groups, and this might be related to different etiology and mechanism of stone formation between upper and lower urinary tract. The lower urinary tract stones that formed in blabber were often secondary to either infection, BOO, or descend from upper urinary tract. This might explain the predominance of Calcium oxalate and phosphate stones in patients $\geq$ 40 years with bladder stones [22]; and the high prevalence of uric acid stone in patients $\leq$12 years with bladder stone which is secondary to UTI, decreased fluid intake and inborn errors of metabolism [23].

The high prevalence of Calcium oxalate and uric acid in upper urinary tract stones with increasing ages could be attributed to the increase in urinary oxalate concentration, and the increase of retained heterogeneous nucleants like organic matter (for example due to hypertension or uric acid crystals) with age [24]. In addition to the high incidence of metabolic syndrome (reduced ammoniogenesis and insulin resistance) with age in both genders [25]; metabolic syndrome could be a causative factor in acidic urine formations with uric acid nephrolithiasis in elderly patients [26].

Cystine stone, in current study, was more prevalent in < 20 years age group. This stone occur as a result of cystinuria caused by inborn error of metabolism, it might occur in early age with equal ratio in male and female [27].

In comparison to Iraqi study by Adnan H. and Meitham [28] described the presence of Calcium oxalate stone in 46.1%, followed by phosphate stone 38.4% and Urate stone 15.4%, while in current study phosphate stone constitute only (10.4%). This variable percent might be due to small sample size taken in this study (only 25 stone), and this relatively high percent in comparison to other series from nearby countries (table 18) might be attributed to increased incidence of UTI in our locality and delay in seeking medical treatment.

Mixed stones also had high percent in overall results (16.5%) and COM+ AU stone form major component of these stones (7.2%).

Cystine stone had relatively high percent in overall stone types (3.7%) in comparison with nearby countries (table 18), and genetic factors play important role in pathogenesis of stone formation. The worldwide prevalence of this stone is 1 % [29].

Matrix stone which is a rare type constitute (2%) of overall results in current study, in

agreement with the result of Hemendra et al [30].

Finally, the table below shows stone types in Iraqi overall patients and large series in Asia and Africa published in last decade.

Table 18: Stone types in current Iraqi overall patients in comparison to other series

Stone type	Current Iraqi study No= 3130	Iran[11] No= 1268	Oman[12] No=255	Morocco[13] No=828	KSA[16] No=307
Caox	46%	80.2%	45%	66.6%	78%
Uric acid	20.4%	16.2%	16%	18.1%	19%
Caox+Urate	7.2%	0 %	4.3%	0%	0%
Calcium ph.	3%*	2.4%	3.1%	8.1%	0%
Struvite	5.4%	0.4%	1.2%	4.4%	3%
Cystine	3.7%	0.6%	4%	0.6%	0%
Others	1%	0.2%	0%	1%	0%

*Ca ph.+ Struvite.

Conclusions

Calcium oxalate stone is the commonest stone type in overall Iraqi patients, with high prevalence in Kurdish patients and in north regions. Uric acid stone is the second most common stone type in Iraqi patients, with high prevalence in Arab patients and in middle regions.

There were increased prevalence of Calcium oxalate and Uric acid stones in 40-59 years and ≥ 60 years old patients respectively, while cystine stone was more prevalent in < 20 years old patients. The variable differences in stone types between Iraqi regions or ethnicities might be correlated with different epidemiological, socio-economic and genetic factors between them.

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