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# EXMINATION OF KIDNEY STONES COMPOSITION WITH THE HELP OF FTIR SPECTROSCOPY

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**Abstract:**

***Objective:*** *The objective of this research work is to analyze the structure and form stones found in kidneys of the patients.*

***Design:*** *This research work was an analytical study.*

***Setting:*** *KS (Kidney Stones) extracted from the patients of Institute of Institute of kidney diseases Hayatabad Medical Complex Peshawar and its associated areas during the period of January 2017 to December 2018.*

***Methodology:*** *The 58 samples of KS gathered haphazardly & their examination carried out for the detection of their type and structure with the help of FTIR (Fourier transform infrared) Spectroscopy.*

***Results:*** *In those fifty-eight samples of KS, 37.90% were complete stones of calcium oxalate, 3.40% were of pure uric acid, forty-four percent were the combination of calcium oxalate & uric acid, 3.40% stones were of calcium oxalate & aspartate and 10.30 were the composition of magnesium ammonium phosphate. The comparison of the bands of Infrared conducted with respect to the standards. The comparison in accordance with gender showed that most of the interrogated stones were from the male patients. The comparison according to age showed that the range of age for the appearance of this disease was from 15 years to 29 years.*

***Conclusion:*** *The results concluded that the stones of calcium oxalate & uric acid are very frequent in the patients of Peshawar and it remotes areas.*

**Key Words:** *Magnesium, Combination, Ammonium, Calcium, Haphazardly, Aspartate.*

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## INTRODUCTION:

The disease of kidney stone is very frequent [1, 2]. The occurrence of this disease in the population of Europe is about 10% [3, 4], although the disparities based on ethnic group and geography among those populations are also in consideration [5]. The disturbance in the excretion or in metabolism can lead to the formation of stones [6] or the crystallization inhibitors can be the victims [7]. The studies on the origin and reasons of this disease presents various risks for this disease as eating habits and hot climate [1, 8]. The identification of the ingredients of the stones is very vital to know about the real source of the disease to tackle the problem from its origin. But unluckily, the composition of the stones varies from area to area, so it is difficult to apply the composition of stones of one area to all other parts of the world [9, 11].

Fourier transform infrared spectroscopy is in use for the examination of the kidney stones [9]. Other normal methods give wrong or incomplete information about the compositions of these stones [10]. The qualitative & quantitative examination of the complete crystal material available in the renal stones is very important to provide a guide the treatment [10].

## METHODOLOGY:

The subjects of this research work were the stones of kidneys which recovered through operation, 58 patients in which 40 were male and 18 were females with an average age from 14 to forty-five years. All the subjects stored on a wire gauze which was sterile to dry with air and then placed in a plastic packet with the number of the sample. Cleanliness of all the samples carried out with the help of distilled water carefully. Samples dried over silica gel for many days. Then the samples changed in to a fine powder and placed into a tube and placed into silica gel until examined for its structure with the help of FTIR. Nicollet Avatar 330 Fourier transform infrared Spectrophotometer made by TEC (Thermo Electronic Corporation) with a frequency range from 600 to 4000 cm-1 was in use for the FTIR spectroscopy.

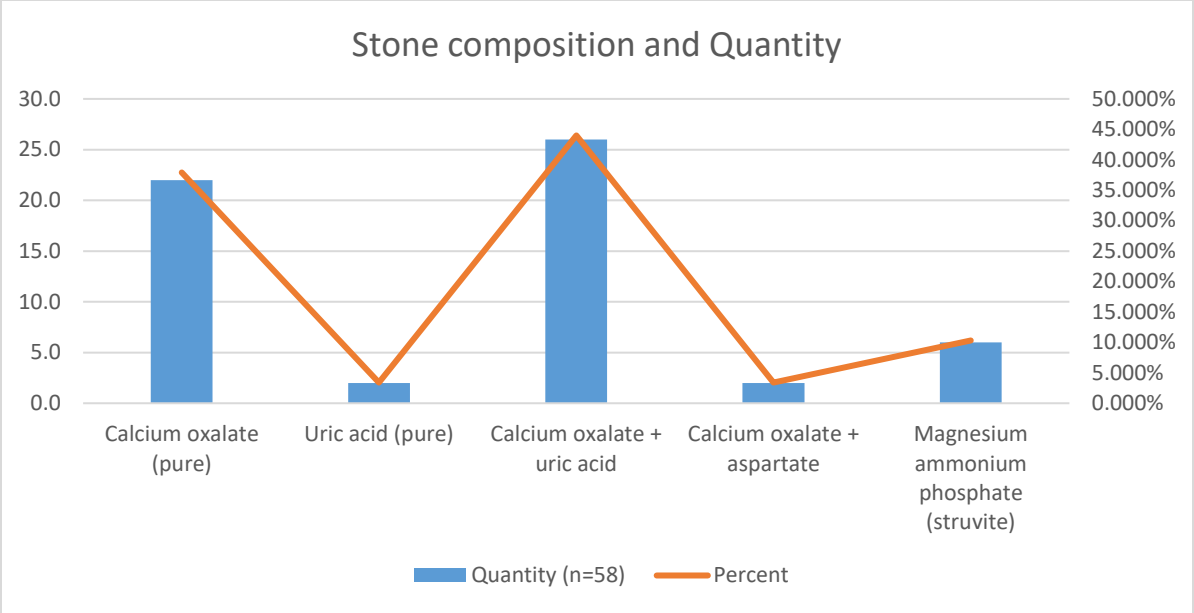
The assessment menu which was the part of Omnic with version 7.0 software which was performing all the method automatically. The preparation of Ideal spectra for very frequent crystalline compositions carried out which were 99% pure bought from E. Merck, Germany. Only homogeneous powder of stones was in use for the FTIR examination. Sloway and Wu method of gallstone examination on FTIR was in use for the analysis of the KS [13].

## RESULTS:

The comparison of the spectra carried out with the Fourier transform infrared spectra of the samples of renal stones. The Fourier transform infrared spectra of samples of kidney stones resembled 90% same to the standards. Table-1 shows the type of the renal stones as discovered & their rate of occurrence. Out of 58 renal stones samples, 37.90% were present with calcium oxalate, 3.40% found with complete uric acid, 10.30% were available with magnesium ammonium phosphate & forty-four percent detected as uric acid plus calcium oxalate.

**Table I : Composition and Quantity of Renal Stones (Patients)**

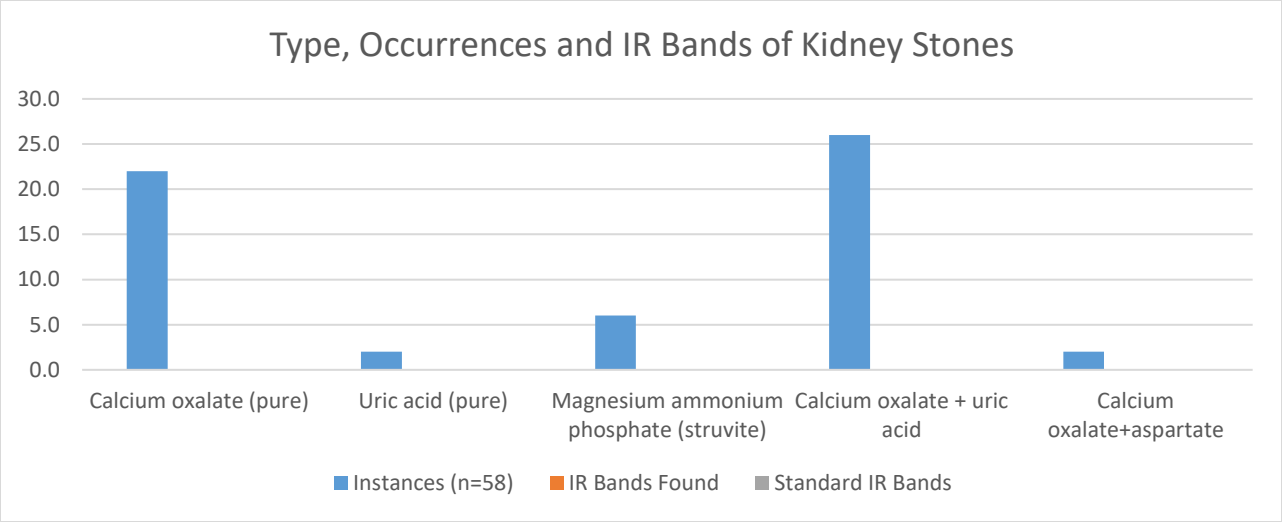
| Stone Composition | Quantity (n=58) | Percent |
|---|---|---|
| Calcium oxalate (pure) | 22.0 | 37.900% |
| Uric acid (pure) | 2.0 | 3.400% |
| Calcium oxalate + uric acid | 26.0 | 44.000% |
| Calcium oxalate + aspartate | 2.0 | 3.400% |
| Magnesium ammonium phosphate (struvite) | 6.0 | 10.300% |



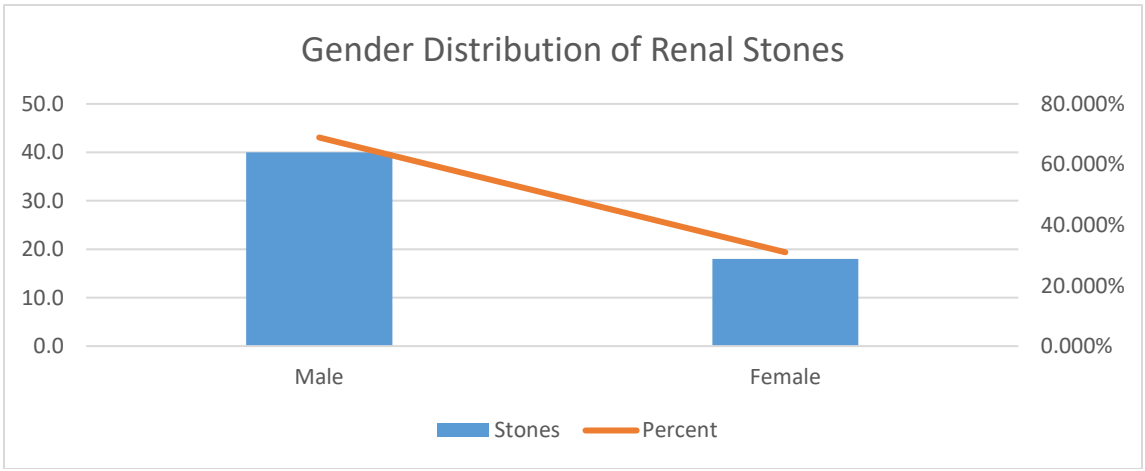

The bands of diagnosis for these compositions are present in Table-2 [14]. The comparison with respect to the sex discovered that most of the KS gathered from the male patients (68.09%) as described in Table-3). The data of comparison with respect to the age discovered that most of the renal stones (37.90%) gathered from the participants of the age group of thirty to forty-four years as mentioned in Table-4. Children of less than 14 year of age were also the bulk risk of acquiring renal stones (31%).

**TABLE II : Type, Occurrence and IR Bands of Principle Components Observed In Kidney Stones**

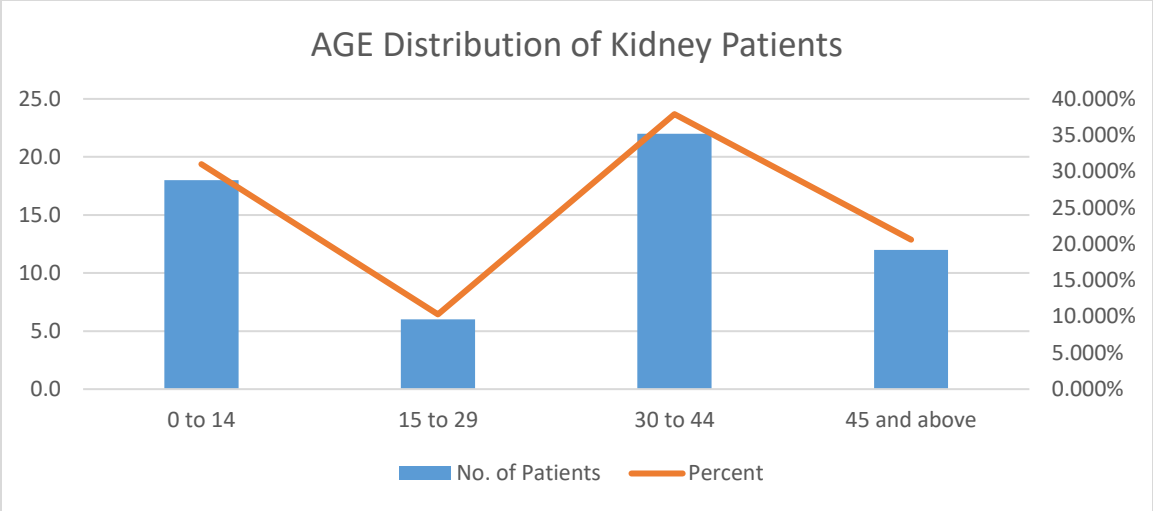
| Composition | Instances (n=58) | IR Bands Found | Standard IR Bands |
|---|---|---|---|
| Calcium oxalate (pure) | 22.0 | 778.960, 1315.620, 1606.870 | 778.530 (C=O asymmetrical stretching), 1314.930 (C-C symmetrical stretching), 1604.640 (OC=O asymmetrical stretching) |
| Uric acid (pure) | 2.0 | 1638.100, 1021.050 | 1637.290 (C=C stretching), 1018.130 (N-H stretching), 738.030 (C-N stretching of aromatic) |
| Magnesium ammonium phosphate (struvite) | 6.0 | 2362.670, 1459.290 | 2362.630 (N-H and C-H stretching), 1469.190 (NH3+ symmetrical bending), 970.530 (P-O-C aliphatic stretching) |
| Calcium oxalate + uric acid | 26.0 | 1019.000, 1314.270, 1637.460, 1635.660 | Same as Calcium oxalate, and uric acid |
| Calcium oxalate+aspartate | 2.0 | Same as in Calcium oxalate, 1607.280, 1315.240, 1030.690 | Same as Calcium oxalate, 1238.510 (C-N stretching), 1208.640 (C-C(=O)-O stretching), 1068.020 (C-CO-O-CO- C stretching) |




| Table III : Gender Distribution of Kidney Stones | | |
|---|---|---|
| **Gender** | **Stones** | **Percent** |
| Male | 40.0 | 68.900% |
| Female | 18.0 | 31.000% |




| TABLE IV : AGE Distribution of Kidney Patients | | |
|---|---|---|
| **Age (yrs)** | **No. of Patients** | **Percent** |
| 0 to 14 | 18.0 | 31.000% |
| 15 to 29 | 6.0 | 10.300% |
| 30 to 44 | 22.0 | 37.900% |
| 45 and above | 12.0 | 20.600% |




**DISCUSSION:**

The data of the renal stone's composition is very important to know about the causes of this disease. Treatment for the disease of kidney stones is dependent on the examination of the calculi, assistance of its ingredients, proper administration for the prevention of disease and prevention of its repeated emergence is not impossible. Hyperoxaluria is the main cause of the development of stones made up of calcium oxalate [15]. The final product of various ways of metabolism is oxalate. Ten to 20% oxalate of urine is available in the main sources of food and foods which are the rich source of oxalate are cranberries [16], tea, chocolate & spinach [16, 17].

The kidney tubular leaking, high absorption of the calcium in the gastro intestine & hyperparathyroidism can be the cause of the hypercalciuria which has the relation with the formation of the stone [18]. The concentration of the urine oxalate has an impact on the saturation of the calcium oxalate as performs concentration of urine oxalate [19]. Any state which enhances the absorption of oxalate from diet and cause the formation of stone of calcium oxalate [20]. Massey in 2005 stated that one thousand milligrams ascorbic acid two times in a day enhanced the urinary oxalate & TRI (Tiselius risk index) for the renal stone of calcium in 40% patients both of no stone formers & formers of stones [21]. The extreme users of green leafy vegetables & tea were the patients of this research work. Morton reported that the stones of complete uric acid are very less [16].

Decrease pH of urine can be a danger aspect for the formation of stone made of uric acid [22, 23]. One method for the urine acidification is the production of NH3 [24, 25]. A decreased creation of NH3 reduces the buffer capacity. The final item of purine degradation in the Homo sapiens is uric acid & kidney is the vital part in the elimination of this product. The unnecessary eating of fish & meat can also the cause of the formation of stones of uric acid [16]. Hyperuricosuria is the result of the high usage of the meat which causes the creation of the stones [20]. The therapy of this disease demands the antibiotic intervention [26]. It is very necessary to maintain the pH value less than 6 to prevent the infection. Soft drinks, protein & citrus juice are some of the diets which has a direct impact on the pH of urine [27]. Some stones are also the creation by the infection of some microbes [16, 28]. Fedric advised that struvite created at the time of due to bacteria that contains the enzyme urease [17]. Males were largely the victims as compared to the females which is the result of the less citrate content present in men [15, 29, 30, 31]. Citrate has the capability to prevent the formation of the stones [32, 33]. When the discharge of the citrate from kidney tabular cell decreases, hypocitraturia happens which causes the creation of the stone formation [16].

Protein plays an important role in the deposition of the calcium oxalate which supports the lithogenic events [17]. The less quantity of the inhibitor of urinary crystallization & pH of less than 5.0 are the some of the causes of the formation of stones [27]. The tackling of the mentioned causes of stone formation can lead to the prevention of this disease [28]. In upper region of Punjab, Pakistan, stones of calcium oxalate plus uric acid are very frequent [30]. Some scholars concluded the most frequent stones of calcium oxalate monohydrate & calcium phosphate [34, 35]. The main cause of the calcium oxalate plus uric acid stones is diet of the patients [36–39].

## CONCLUSION:

The most frequent composition of renal stones is calcium oxalate with the addition of uric acid in the population of Peshawar and its associated areas.

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