

Analysis of renal stones; Analysis and Epidemiology

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Abstract

The study was comprised of the chemical analysis of certain constituents in the 100 renal calculi samples that were collected from the District Khairpur randomly and the study of the samples was evaluated by the frequency of occurrence on the basis of age and Sex and their morphological composition. A quantitative analysis was derived by the mean of highly sensitive techniques and the ethics was also included. One-hundred calculi samples were obtained from patients admitted in Khairpur Medical college and Gambat Institute of Medical Sciences. 68 were male and 32 were female Urolithiasis patients. The most cases were observed in the age group between 16-30. The calculi samples were subjected for qualitative as well as quantitative analysis, for determination of calcium, phosphorus and oxalate that are the main constituents of the calculi. Morphological examination was also conducted on the basis of color, size, shape and weight.

Keywords: stones, urolithiasis, End Stage Kidney Disease, Chronic Kidney Disease, Calcium oxalate,

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DOI: 10.53778/pjkd73241

Received Dec 15, 2023 and accepted

PJKD 2024;8(1):21-26

Introduction

Background

History shows the existence of the Urolithiasis disease and the formation of renal stones or calculi in the renal tract is the earliest and the most common Greek condition of human distress. Urinary stones were evidently found from 7000 years prehistoric Egyptian mummies. Hippocrates stated that the stones are soil like sandy materials and much utilization of water results the emission of these hard or grainy crystals in the urine. Former statement has been disclosed in the residues of the Egyptian Mummies (Moran, 2016). Ubiquitously then, the calculi was considered into three categories kidney, bladder or urinary calculi according to the location of the calculi forms. Galen a Roman physician acquiesced that there are many factors which are responsible for giving rise to the formation of stones i.e. Atmosphere, genetic, diet, sex and race conceivably participate the probability of such condition. Development of calculi or stones in the ureters, kidneys, bladder and urethra is assembled as a disease called urolithiasis this disease includes the existence of calculi in the urinary tract (Goyal, 2017).

Urolithiasis

Urolithiasis is characterized as the development of obstructive pebble like granules that are gathered and cause much irritation and sore in the urinary locale such condition is termed as the development of urolithiasis in the human urinary tract (Muslumanoglu *et al.*, 2011). This medical condition comprises a few torments while the presence of renal stones in different site or person to person can be specified altogether in different manners, as it does not create sores or indications and can pass easily with urination, whereas, it can cause distress accompanying indications like hematuria and follows by urinary infections (Pang and Catto, 2020). It is viewed as a vulnerable health hazard in present period and much of the population is likewise to be susceptible to this disease more than once in their life span however this ailment is documented from antiquated times nevertheless the classification has been changed. Some factors that associate with this condition accompany by infections depending on the formation of calculi

at the unfavourable location or size that restricts or halts the urinary tract and passage of urine as well. Another perceptible change is sexual-based occurrence in the men or women which varies with the

Figure 1: Physical appearance of some kidney stones

individuals who are influenced. Previous data shows that the men were prone to the urolithiasis disease



and the most part was analyzed with men, however, nowadays, ladies are likewise exposed to the possibility of the development of renal stones (Nayak and D'Souza, 2019). Numerous medicines and preventive techniques are considered for better results and to reduce the incidences of this disease.

Renal calculi

The calculi development and collection in the urinary tract causes formation of renal calculi commonly known as kidney stone, it is a condition that is common all through the social orders of the globe. The condition might be alluded as urolithiasis, ureterolithiasis or nephrolithiasis. The term 'Lith' characterizes a stone and the area is characterizing "Nephrolithiasis" (term alludes; calculi development inside of the kidney), Ureterolithiasis (term alludes; calculi development in the ureter) and Urolithiasis (term alludes; calculi development within the urinary tract) (Fontenelle and Sarti, 2019). Multiple terms are utilized to characterize deposition calculi in the urinary system as uroliths, kidney stones, renal calculi or urinary calculi (Agawane *et al.*, 2019). Renal calculi, likewise called renal or kidney stone is the deposition of mineral salts aggregate as precipitations into solid crystals that gather in the renal system or tract. Calcinosis is based on the arrangement of supersaturation of salts i.e., Oxalates, phosphates etc (stone forming) in the urine. Calculi develops by the collection of calcino stones aggregating constituents in urine and originate into multiple stones (calculi), sometimes, a single stone forms that is referred as single stone (calculus). The nucleation or development of the smaller granules results into formation of huge liths, stones or calculi (Wesson *et al.*, 2019). Calculi are combination, made out of calgranulin, minerals, deposited salts, and different aggravates which form in urine and assemble in kidneys, bladder, urethra or in multiple places in the urinary tract. Kidney or renal calculi takes a very long time or years to develop yet they develop gradually

Composition

Renal calculi is mostly composed of calcium, Magnesium, Iron, cobalt, lead and other minerals that form dissolvable compounds along with ammonium, phosphate and oxalate, whereas, some calculi are made-up of organic constituents like uric acid, cysteine and xanthene. According to these components renal calculi are categorized as Calcium phosphate, Calcium oxalate, and Magnesium ammonium phosphate also known as Struvite, uric acid, and cysteine calculi (Malik and Hussain, 2019). Among these type of calculi, calcium oxalate is predominating and the most prevalent than others like calcium phosphate, Struvite, Uric acid and mixed calculi (Ruiz-Agudo, 2017).

Morphology

Renal calculi can differ in size, quantity, colour and shape or structure from individual to individual. It appears sometimes as little as grain of sand or as bigger as golf ball. It can cause obstruction all out urinary tract and renal system. Kidney stones shapes might be harsh, smooth, barbed, rugged, round, awry angular or horny. Colour of these stones can be whitish, yellowish, muddy, black, and brown or can be caramel, ruddy or in multiple shading (fig. 1). Its size may cause different complexities, the larger size renal stone passes hardly and could be painful while calculi with smaller size start irritation and thwarting the tracts results infections as well, it tends to go through urethra or ureter by painful experience and can be exceptionally agonizing, granules or little stones pass effectively by urination. Calculi with bigger size are often difficult to pass through the urination within urinary tract and foremost calculi which have sharp nodes and edges or harsh structure cause torment during passing out from the urinary tract.

Materials and methods

Study Setting

The study was designed through randomly collection of samples from District Khairpur, Sindh. Demographical Khairpur city is consisted 2,404,334 populations. The research was consisting of the patients of urolithiasis registered into the hospitals of Khairpur District at Khaipur Medical College (KMC) and at Gambat Institute of Medical Science (GIMS).

Chemicals and apparatus

The assembled specimen was washed with water and dried for 48 hours at room temperature. After morphological note-down, samples were weighed and ground afterward until transformation into powder then the powdered samples were weighed.

Experimental

Sample Preparation

0.5 g of samples was weighed precisely then processed utilizing 2 mL of concentrated HNO_3 and 6 mL of concentrated HCl . 25 mL volume was made up utilizing distilled water. 1 mL of this stock was additionally drawn up to 100 mL utilizing distilled water.

Estimation of Calcium

O-cresolphthalein complexone method was used for Calcium estimation, quantitatively. Magnesium was seen to be interfering the complexation by forming magnesium ortho cresolphthalein complexone as well, hence, and interference of magnesium was removed using 8-hydroxyquinoline as masking agent.

Estimation of Phosphate

The phosphate determination was carried out by using phosphomolybdate reaction. Samples were treated with Ammonium molybdate to form phosphomolybdate in order to determine phosphorus.

Estimation of oxalate

Determination of Oxalate was carried out by oxidation of KMnO_4 by oxalic acid as reverse method using UV-Vis spectrophotometer

Results

The results were obtained by chemical analysis of renal calculi. Table 1 illustrates the content of oxalate, phosphate and calcium in the samples observed and their average weight was estimated. All the samples were analyzed and distributed in various types of calculi on the basis of appearance, color, structure and chemical parameters.

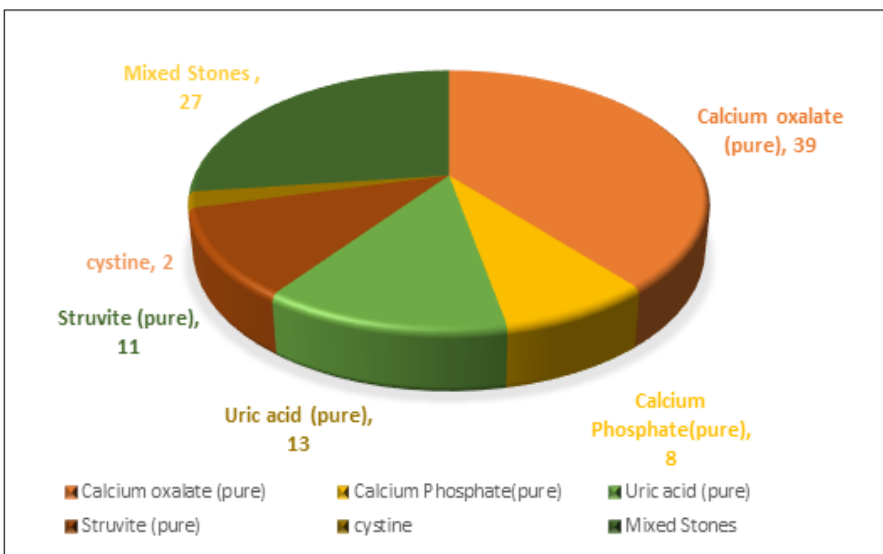


Figure 2: Types of renal calculi samples

Figure 2 illustrates the distribution of the samples into 6 types that were further analyzed for their content parameters. Samples were also analyzed according to epidemiological pattern on the basis of age and sex. Different ages and incidences were also noted.

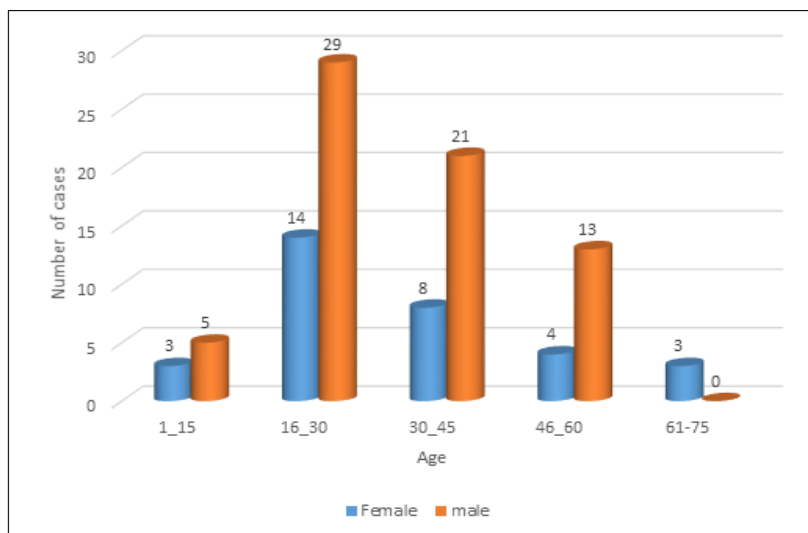


Figure 3: Age and gender distribution among 100 stone formers.

Parameters	Composition of calculi (mg/g)					
	Ca-oxalate	Ca-phosphate	Uric acid	Cystine	Struvite	Mixed
Calcium Mean $\pm$ SD	33.5 $\pm$ 4.7	27.2 $\pm$ 2.8	4.16 $\pm$ 0.5	3.76 $\pm$ 0.2	6.74 $\pm$ 1.1	8.92 $\pm$ 1.5
Oxalate Mean $\pm$ SD	27.8 $\pm$ 3.6	1.91 $\pm$ 1.1	17.7 $\pm$ 1.8	13.3 $\pm$ 0.3	4.19 $\pm$ 1	9.02 $\pm$ 1.9
Phosphate Mean $\pm$ SD	1.16 $\pm$ 0.4	13.3 $\pm$ 1.8	4.18 $\pm$ 0.4	4.28 $\pm$ 0.5	16.3 $\pm$ 2.1	8.25 $\pm$ 0.9

Table 1: chemical composition of stones obtained from 100 stone formers in Khiarpur district, Pakistan.

Discussion

Many natural elements are vital to human body major and trace minerals are essential for human health with adequate consumption in the course of breathing, drinking or eating (Al-Fartusie and Mohssan, 2017). These trace elements are specific for processes of metabolism, but its huge amount temporarily stocks in the kidneys and excretes in the urine as well. This excretion may lead the formation of renal calculi and give rise to the incidences of urolithiasis as this condition does not treat immediately (Waikar, 2019). Study was aimed to analyse the role of some major constituents in the content of renal calculi that are widely responsible for urolithiasis among human. Samples were analysed and categorized as mixed, calcium oxalate, calcium phosphate, uric acid uric acid and struvite stones. The major constituent among all calculi was Calcium. The most common calculi were Calcium oxalate calculi followed by mixed, struvite, uric acid and calcium phosphate. Age plays an important role in the susceptibility with the formation of renal calculi. It was noticed that the age 16-30 is the most likely to impose with such scenario. Male to female ratio shows that the men are more prone to the disease. Water consumption plays an important role in the prevention against urolithiasis whereas the consumption of food with high oxalate content like spinach, beets, tomatoes rhubarb and parsley can increases the chances of formation of renal calculi (Robertson, 2016).

Conclusion

The research of the topic was based on sampling assessment and analysis of basic parameters with holdings of the epidemiological and morphological study. The outcomes of the research are based on the contents of oxalate, calcium and phosphate in the renal calculi taken from the district Khairpur patients. After analysis it was obviously found that the oxalate plays an important role in the formation of calculi as it was the most common substance among the calculi and the most common calculi was found to be oxalate calculi. Secondly, it was observed that women are more prone to the urolithiasis than that of men. Thirdly ages were seen to be apparently playing their part as the most common ages for urolithiasis were 16- 30 years.

Conflicts of interest There are no conflicts to declare.

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