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Research Article

Preliminary Study on the Results of the Analysis of Urinary Stones by Infrared Spectrophotometry in the Urology Department of the Pr BSS University Hospital in Kati

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Abstract

Introduction: Urinary lithiasis corresponds to the presence of one or more stones in the urinary tract. The etiology is multiple. The etiological investigation of urinary stones is based on morpho-constitutional analysis by infrared spectrophotometry. The objective of this work is to report the preliminary results of the analysis of urinary stones by infrared spectrophotometry. Materials and methods: This was a descriptive cross-sectional study with prospective collection carried out in the urology department of the Pr Sidy Sall University Hospital in Kati. It took place over a period from January 1, 2016 to December 31, 2018, or 36 months. Included in our study were all patients who were diagnosed with urinary lithiasis and who underwent spectrophotometric analysis after the intervention in the department. The supports of our study were: consultation records, surgical report records, hospitalization records, medical records, and the account of the analysis of stones by infrared spectrophotometry. The questionnaires were entered and analyzed on Word 2016, Excel 2016 and SPSS version 23.0 software after data verification. Results: we collected eighty-one (81) cases of urinary stones. Of the 81 cases, 15 patients were able to perform an infrared spectrophotometry analysis. In 66.67% of cases, there was at least 1 stone. In 60% of cases, the stone was of medium size. The stones were brownish in color in 73% of cases. Whewellite C1 and C2 stones were the most represented. In only one patient, the chemical composition of the stones was essentially made of whewellite. In a single patient, the chemical interpretation was essentially made of dietary hypercalciuria. The concentric and radial aspect of the calculus was essentially found in a single patient.

Keywords

Urinary Stones, Infrared Spectrophotometry, Etiology

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1. Introduction

Urinary lithiasis corresponds to the presence of one or more stones in the urinary tract. It is a common pathology that affects between 4 and 20% of the population depending on the country [1]. The etiological investigation of urinary stones is based on morpho-constitutional analysis by infrared spectrophotometry, and on a biological assessment guided by clinical and medical imaging data [2-4]. Infrared spectrophotometry is a method of qualitative and quantitative analysis of the constituents of urinary stones. The analysis of stones by reliable physical methods such as microscopy and infrared spectrophotometry makes it possible to accurately determine the structure and chemical composition. This result allows the clinician to focus on metabolic or nutritional pathologies that led to the lithogenic process [5].

The objective of this work is to report the preliminary results of the analysis of urinary stones by infrared spectrophotometry.

2. Materials and Method

Study setting: This study was conducted in the urology department of the Pr Bocar Sidy Sall University Hospital Center in Kati.

Type of study: This was a descriptive, cross-sectional study with prospective collection conducted in the urology department of the Pr Bocar Sidy Sall University Hospital Center in Kati.

Study period: It took place over a period from January 1, 2016 to December 31, 2018, or 36 months.

Study population: It consisted of all patients hospitalized in the department during the study period for urinary lithiasis and who underwent an infrared spectrophotometry analysis.

Sampling: Our study sample was exhaustive (all patients hospitalized in the department during the study period for urinary lithiasis).

Inclusion criteria: Included in our study were all patients who were diagnosed with urinary lithiasis and who underwent spectrophotometric analysis after surgery in the urology department of the Kati Pr Bocar Sidy Sall University Hospital.

Data support: The supports of our study were: consultation records, surgical report records, hospitalization records, medical records, and the account of the analysis of stones by infrared spectrophotometry.

Data analysis: The questionnaires were entered and analyzed on Word 2016, Excel 2016 and SPSS version 23.0 software after data verification.

3. Results

During this study period, we collected eighty-one (81) cases of urinary stones. There were 60 men and 21 women (sex ratio M/F = 2.86/1). 398 cases of surgical intervention were performed, including 81 cases of urinary stones, i.e. a hospital frequency of 20.35%. The mean age was 34 ± 19.07 years with extremes ranging from 1 year to 81 years. The age group from 21 to 30 years was the most represented, 21 cases or 25.9%. Of the 81 cases, 15 patients were able to perform an infrared spectrophotometric analysis. In 66.67% of cases there was at least 1 stone (Table 1). In 60% of cases the stone was of medium size (Table 2). The stones were brownish in color in 73% of cases (Table 3). Whewellite C1 and C2 stones were the most common (Table 4). In only one patient, the chemical composition of the stones was essentially whewellite (Table 5). In only one patient, the chemical interpretation was essentially dietary hypercalciuria (Table 6). The concentric and radial aspect of the stone was essentially found in only one patient (Table 7).

Table 1. *Distribution of patients according to the number of stones extracted and sent for infrared spectrophotometric analysis (n=15).*

Nomber of stone	Effective	Percentage (%)
1	10	66,67
2	1	6,66
3	1	6,66
Greater than 3	3	20,0
Total	15	100,0

In 66.67% of cases there was at least 1 stone.

Table 2. *Distribution of patients according to the form of stone extracted and sent for infrared spectrophotometric analysis (n=15).*

Stone size	Effective	Percentage (%)
Medium	9	60
Small	4	27
Coralliform	2	13
Total	15	100

In 60% of cases the stone was of medium size.

Table 3. *Distribution of patients according to the color of the stone extracted and sent for infrared spectrophotometric analysis (n=15).*

Couleur du calcul	Effective	Percentage (%)
Brownish	11	73
Blackish	3	20
Yellowish	1	7
Total	15	100

The stones were brownish in color in 73% of cases.

Table 4. *Distribution of patients according to the type of stone.*

Stone type	Effectif
Whewellite C1	14
Whewellite C2	11
Carbatite Hydroxy Ca	10
Proteine	8
Whitlockite	3
Struvite	1

Whewellite C1 and C2 calculi were the most represented.

Table 5. *Distribution of patients according to the chemical composition of the stones.*

Patients	Chemical composition
1	Whewellite 45%, Weddellite 20%, Carbatite 30%, Prot éines 5%
2	Whewellite 80%, Carbatite 15%, Prot éines 5%
3	Whewellite 75%, Weddellite 15%, Carbatite 10%
4	Whewellite 82%, Weddellite 15%, Prot éines 3%
5	Whewellite 5%, Weddellite 70%, Carbatite 20%, Prot éines 5%
6	Whewellite 55%, Carbatite 30%, Prot éines 10%, Whitlockit 5%
7	Whewellite 75%, Weddellite 20%, Prot éines 5%
8	Whewellite 45%, Carbatite 15%, Weddellite 35%, Whitlockit 5%
9	Whewellite 30%, Weddellite 15%, Carbatite 45%, Prot éines 10%
10	Whewellite 20%, Weddellite 40%, Carbatite 30%, Prot éines 10%
11	Whewellite 80%, Weddellite 20%
12	Whewellite 20%, Weddellite 50%, Carbatite 30%
13	Whewellite 35%, Carbatite 50%, Prot éines 10%, Whitlockit 5%
14	Whewellite 85%, Weddellite 15%
15	Whewellite 100%

In only one patient, the chemical composition of the stones was predominantly whewellite.

Table 6. *Distribution according to clinical interpretation.*

Patients	Clinical interpretation
1	Hyperoxaluria of flow or concentration, Cacchi Ricci disease, hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
2	Hyperoxaluria of flow or concentration, Cacchi Ricci disease, hypercalciuria, non-urea germ infection
3	Intermittent hyperoxaluria, Cacchi Ricci disease, hypercalciuria

Patients	Clinical interpretation
4	Intermittent hyperoxaluria, Cacchi Ricci disease, hypercalciuria
5	Hypercalciuria, primary hyper PTH
6	Output or concentration hyperoxaluria, hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
7	Intermittent hyperoxaluria, Cacchi Ricci disease, hypercalciuria
8	Hyperoxaluria of flow or concentration, hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
9	Hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
10	Hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
11	Intermittent hyperoxaluria, Cacchi Ricci disease, hypercalciuria
12	Hypercalciuria, primary hyper PTH, phosphate DT, non-urea germ infection, tubular acidification disorder
13	Output or concentration hyperoxaluria, Hypercalciuria, primary hyper PTH, phosphate DT, non-urease germ infection, tubular acidification disorder
14	Old hyperoxaluria with urological stasis
15	Dietary hypercalciuria

In only one patient, the chemical interpretation was essentially dietary hypercalciuria.

Table 7*. Distribution according to the morphological aspect of the stones.*

Patients	Morphology	
	Peripheral aspect	Section aspect
1	Heterogeneous, crystalline, bumpy, spiculated, sharp edges	Heterogeneous, crystalline, concentric and radial to crystalline, microcrystalline, unorganized to lacunar
2	Heterogeneous crystalline, bumpy, rough and speculated with blunt edge	Heterogeneous, crystalline, microcrystalline, concentric and radial, unorganized
3	Homogeneous, crystalline, spiculated, opaque with blunt edges and angles	Heterogeneous, crystalline, concentric and radial unorganized
4	Heterogeneous, crystalline, bumpy, mammillary, spiculate with blunt edges with ramifications	Heterogeneous, crystalline, bumpy, concentric, and radial to inorganic
5	Homogeneous, crystalline, spiculated, noisy and translucent crystals	Heterogeneous, crystalline, radial+/-lacunar crystallization
6	Heterogeneous, crystalline, bumpy, rough	Heterogeneous, crystalline, microcrystalline, unorganized, fibrous, concentric, radial in surface periphery
7	Heterogeneous, crystalline, bumpy, spiculated with sharp and blunt edges	Heterogeneous, crystalline, concentric, radial, unorganized
8	Heterogeneous, crystalline, rough, spiculated with blunt edge	Heterogeneous, crystalline, microcrystalline, unorganized
9	Heterogeneous, crystalline, microcrystalline, cracked, rough	Heterogeneous, crystalline, microcrystalline, unorganized
10	Heterogeneous, crystalline, rough with sharp edges, bumpy	Heterogeneous, crystalline, microcrystalline, unorganized, concentric, radial
11	Heterogeneous, crystalline, spiculated with sharp and blunt edges	Heterogeneous, crystalline, microcrystalline, concentric

Patients	Morphology	
	Peripheral aspect	Section aspect
12	Heterogeneous, crystalline, microcrystalline, cyanotic, spiculate with sharp edges, blunt	Heterogeneous, crystalline, microcrystalline, unorganized
13	Heterogeneous, crystalline, microcrystalline, rough	Heterogeneous, crystalline, microcrystalline, concentric, unorganized
14	Heterogeneous, crystalline spiculate with intertwined crystals, opaque at blunt edges and angles	Heterogeneous, crystalline, unorganized, lacunar
15	umpy, smooth	Concentric, radial

The concentric and radial aspect of the calculus was essentially found in only one patient.

4. Discussion

Infrared spectrophotometry is a physical technique of molecular analysis. First proposed in 1955 in the United States by Berscher. It gained its popularity as a method of calculus analysis only thanks to the work of several European teams in the 1970s and 1980s.

In the study of EL Kabbaj S and al. [5], the morphological examination coupled with infrared spectrophotometry made it possible to characterize whewellite type Ia or Ib (calcium oxalate monohydrate) whose main etiology was intermittent hyperoxaluria (case Ia) or hyperoxaluria-stasis (case Ib). Whewellite type C1 and C2 stones were the most represented in our study. The chemical compositions of whewellite and Weddellite were also the most represented in our work. We had only one patient, in whom the chemical composition of the stones was mainly made of whewellite. In men, whewellite is predominant between the ages of 36 and 40 and decreases with age [5].

In several studies, including that of Pablo Kuntima Diasiama et al. [6] and Lemoufid and al. [7], whewellite was the main body of stones. Whewellite represented 75.5% followed by uric acid, the second major body (15.5%) in the study of Pablo Kuntima Diasiama et al. [6]. These stones composed of whewellite, with a fairly large average diameter, are often associated with renal failure, reflecting the late nature of treatment [6]. In the study of Lemoufid and al. [7] Calcium oxalate monohydrate (whewellite) was also predominant in 43.2% of stones and in 40.2% of nuclei, uric acid in 26.5% of stones.

Analysis of the nature of the stone is an important element in the etiological investigation. As soon as the stone is available (even by spontaneous emission by the patient), the morpho-constitutional analysis of the urinary stone with examination by infrared spectrophotometry allows to identify the etiology. The morpho-constitutional analysis of the stones allows to recognize reliably and quickly rare and specific crystalline species of particular lithogenic contexts [8].

According to the work of certain authors [9, 10], it has been shown that whewellite is oxalate-dependent and crystallizes in an environment of hyperoxaluria with normal or low calcium, while weddellite is observed in a hypercalciuric environment with normal or moderately increased oxaluria. Stone disease is a very common pathology in our context. It requires medical management based on a precise etiological investigation and, where appropriate, appropriate urological treatment.

This etiological investigation is based primarily on the morphoconstitutional analysis of the stone by infrared spectrophotometry in the search for an etiology [11]. The chemical interpretation is diverse, in a single patient, the chemical interpretation was essentially made of dietary hypercalciuria. The concentric and radial aspect of the stone was essentially found in a single patient.

The analysis of the stone by infrared spectrophotometry allows a precise and reliable quantitative method of stone analysis [12]. Knowledge of the precise chemical composition of urinary stones can allow the establishment of appropriate preventive treatment even in the absence of detectable metabolic abnormalities. This makes it possible to prevent and/or delay the recurrence of urinary stones [12].

This preliminary study has limitations that we will take into account in the interpretation of the results. The small size of our sample, the possible existence of the unrecognized metabolic syndrome and the monocentric nature (carried out in a single department, thus preventing the generalization of the results to the population). A large-scale, prospective, multicenter study would allow us to better study the morpho-constitutional analysis of calculus by infrared spectrophotometry in the search for an etiology. This study allowed us to have an idea of the chemical composition of calculi by infrared spectrophotometry analysis.

According to the work of R. Benrabah et al. [13], visual endoscopic recognition in ureteroscopy of the morphology of urinary stones is a feasible approach with demonstrated validity and given their epidemiological profiles of stones, their results show very encouraging concordance rates. To distinguish the main types of lithiasis and their etiologies, the exact identification of molecular and crystalline species, infrared spectroscopy is the reference for the analysis of kidney stones [14]. This importance of analysis has also been emphasized by Zhang J [15]. They report that statistical analysis of infrared spectroscopic composition of stones in patients from Liuyang area provides an important reference for the prevention and treatment of urolithiasis in this population [15]. Analysis of urinary stones by infrared spectrometry allows to specify the etiology and to adapt the patient's diet. Currently with the new techniques of fragmentation of stones with LASER, urologists will perform an in situ pulverization of stones more and more fine, the exact identification of the compounds which form the stone is essential for the etiological diagnosis. A constitutional analysis by infrared spectrophotometry or by X-ray diffraction is therefore recommended, to be completed by a morphological typing of the stones [16]. This preliminary result of the analyses of urinary stones by infrared spectrophotometry with the availability of laser ureteroscopy in our center makes it possible to improve the management of urinary stones.

5. Conclusion

Lithiasis is a common pathology of diverse etiology. The analysis of calculi by infrared spectrophotometry examinations makes it possible to identify the type of calculus, the chemical composition, the morphological aspect of calculi in order to confirm the etiology.

Abbreviations

PTH Parathyroid Hormone

Conflicts of Interest

The authors declare no conflicts of interest.

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