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RESEARCH ARTICLE

ORIGINAL PAPER: CHEMICAL "SPOT TEST" OF URINARY CALCULI IN BIHAR

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ABSTRACT

Aim: Anthropologic history provides evidence that urinary calculi existed since time immemorial. Accurate knowledge of the qualitative and quantitative composition of the urinary calculi is vital for understanding calculogenesis and development of prophylactic measures.
Method: Chemical "Spot test" is the common and practical test for chemical analysis of urinary stone done by Winer and Mattice Urinary stones are multicomponent system and identification of the constituents in urinary Calculi may enable the investigator to accurately characterize the ionic conditions prevailing at the time of nucleation and growth.
Result: Winer and Mattice "Spot testing" have proven to be simplified and reliable & cheap method of analysis of urinary calculi with only 2% error in detection of components of calculi. On Moh's Scale of hardness (2-5) 93.33% stones were present. 46.67% calculi were pure and 53.33% were mixed in nature. In pure variety oxalates were 30% and phosphates 13.33%. In mixed calculi the most common combination was oxalate+phosphate+urates constituting 20%.
Conclusion: Chemical "Spot test" is accurate in detecting the components of urinary calculi. Spot test is simple, reliable and cheap method of chemical analysis of urinary calculi. For the practitioners without access to large analytic laboratories, the most useful, relatively simple and cheap method is chemical Spot test to formulate a therapeutic plan that will be useful in preventing future stone diseases and recurrences. Knowledge of the percentage composition of urinary calculi contributes to the ability to predict the most probable cause of that calculus.

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INTRODUCTION

Urolithiasis is a global phenomenon. New frontiers have developed not only on therapeutic lines as well as on understanding the process of calculogenesis (Aggarwal, 1971; Beeler *et al.,* 1964; Hazarika *et al.,* 1974). Knowledge of composition & analysis urinary calculi yields fundamental information regarding calculogenesis and the formulate decisions and therapeutic plan that will be usefull in preventing future stone disease in that patient (McCarrison, 1931). The most common and practical test in clinical laboratory is chemical analysis by Winer and Mattice 1943 (Mitcheson *et al.,* 1983). Chemical "Spot Test" was best practical method in Hospital laboratories as there was only a 2% error in detection of components of urinary calculi (Prien, 1968; Rodgers *et al.,* 1982; Spector *et al.,* 1978).

MATERIALS AND METHODS

90 urinary calculi of patients after surgical extraction from December 2002 to March 2009 in Anupama Nursing Home, Patna were washed and dried at room temperature. Physical properties studied were stone were stone load (number of stones), shape, color, weight and hardness of stone on Moh's scale The powder pieces collected from a stone were pulverized in a small agate mortar. Chemical "Spot test" of Winer and Mattice (1943) was used for chemical analysis and reports were tabulated and analyzed.

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Observation

A retrospective study of 90 cases of urolithiasis admitted in, Anupama Nursing Home, Patna were carried out. Majority of calculi were present in males 66.67%. Majority of calculi were single 83.33% only 16.67% were multiple. 33.33% were oval. Majority of calculi were greyish 40% followed by white 23.3% weight range of the sample was 4.1gm to 30.2gm On Moh's scale of hardness 2-5 (93.33%) stones were present.

Table A. Chemical Composition of Different Radicals Constituents on Spot tests

Radical	Upper Urinary Tract N = 54 %	Lower Urinary Tract N = 36 %
Calcium	88.88	100
Oxalate	77.78	75
Phosphate	38.88	41.6
Magnesium	5.56	25
Ammonium	27.78	50
Urate	5.56	41.6
Carbonate	-	8.83

The chemical composition analyzed showed majority of upper urinary tract calculi had calcium, oxalate and phosphate. In comparison lower urinary tract calculi have more calcium, magnesium, ammonium and urates.

DISCUSSION

Blandy (1977) postulates that "the urinary stones has an elaborate structure in which there is an organic scaffold and a "Filling" of crystalline material in this retrograde hospital

Table B. Pure Stone by Chemical Spot test

Types of stone	UUT		LUT		Total	%
	M	F	M	F		
1. Calcium oxalate	6	9	9	3	27	30.00
2. Phosphate						
A. Triple	---	3	---	---	3	3.33
B. Double	---	---	---	---	---	---
C. Single	6	---	---	3	9	10.00
3. Uric acid	---	3	---	---	3	3.33
Total	12	15	9	6	42	46.67

Table C. Mixed Salt by Chemical Spot test

1. Oxalate + uric acid	12	---	---	---	12	13.33
2. Oxalate + uric acid +ammonium	---	3	9	---	12	13.33
3. Oxalate + phosphate	---	3	3	---	6	6.67
4. Oxalate + phosphate + uric acid	6	3	9	---	18	20.00
Total	18	9	21	0	48	53.33

Table D. Radicals by Chemical Spot test

Radical	Present series n=90 calculi		Balkrishna Gupta & Rangnekar 1969 Gwalior n=225	Parikh & Shah 1960 Ahmedabad N=63 %	Andersan 1963 Ahmednagar n=30 %	Newcomb & Rangnathan 1930 Conoor N=226	Herring 1962 America 10,000
	No. Of cases	%					
Calcium	84	93.33	99.5	100	90	99.5	81.5
Magnesium	15	16.67	10.6	28.5	26.6	71.6	15.7
Phosphate	36	40.0	91.5	100	100	54.3	79.7
Oxalate	66	73.33	61.7	38.0	96.6	82.8	73.0
Urate	36	40.0	77.7	76.1	10.0	84.6	0.87
Uric acid	3	3.33	0.4	---	13.3	---	9.44
Ammonium	33	36.67	81.3	90.4	16.6	---	---
Carbonate	3	3.33	0.8	15.9	---	---	---
Fibrin	---	---	18.2	---	---	---	---
Cystine	--	--	--	1.5	---	---	---

Table E. Salts on Chemical Spot testing

Combination of radicals	Present series		Balkrishnan *et al.* 1964 Gwalior n=225	Mccarrison Connoor n=226	Moore 1911 Britain n=24
	No. Of cases 90	%			
Pure uric acid + urate	3	3.33	3.1	6.63	8.3
Pure oxalate	27	30	3.5	5.57	12.5
Pure phosphate	9	10	4.0	1.32	---
Phosphate + oxalate	9	10	13.3	10.17	12.5
Urate + phosphate	12	13.33	31.3	8.85	---
Urate + oxalate	18	20.00	1.5	34.50	12.5
Urate + oxalate + phosphate	6	6.67	43.1	32.74	54.1

In this study, 46.67% calculi were pure and 53.33% were mixed in nature. In the pure calculi group calcium oxalate 30% was the most common and single phosphate was 10%. In mixed calculi group the most common combination was oxalate + phosphate + urate constituting 20% followed by oxalate + uric acid +ammonium 13.33% each.

based study records were analyzed to obtain basic data (Sutor *et al.,* 1974; Winer and Mattice, 1943; Boyce and King, 1959; Prien *et al.,* 1982). In lower urinary tract, out of 36vesical calculi,15 stones 26.67% were found in the age group below 15 years. This finding coincides well with the findings of Romanesand & Mitchner 1952 who had observed that bladder stones are common at two extremes of life, whereas upper

urinary stones were seen usually in middle age group 15-45 years. Majority of patients in our study were in the third and fourth decades of life 43.33%. Male preponderance 66.67% was seen. Hugelett 1936 gave the ratio of male and female incidence in different sites as kidney 1:1 ureteric 2:1 and bladder 11:1 My series supports his views respectively.

Analysis of the urinary calculi by chemical method has been the commonly available and economically feasible method to know the composition of stone. Beeler *et al.* 1964 concluded that chemical method is most suitable for routine use. The composition of urinary calculi are variable differs from country to country (Lonsdale, Sutor) and show regional variations. Table A, B, C, D and E show the incidence of different radicals and salt composition in our calculi as salt composition in our calculi as compared to others. Our observation revealed that pure stone accounted for only 42 out of 90 calculi of which 27 were oxalates and 15 were phosphate and uric acid.Winer and Mattice's "Spot Testing" have proven to be simplified and reliable method of analysis of calculi. There is 2% error in detecting components of calculi by "Spot Test" method Schneider *et al.* 1973 (Finlayson and Reid, 1978; Herring, 1982; Kabra *et al.,* 1972). This method determines only the presence of radicals and cannot general identify a compound as such let alone the components of a mixture Sutor 1969 Crystallographic analysis and X-Ray diffraction analysis gives more accurate analysis of urinary calculi and evaluates constituents in the calculi (Rajesh Narayan, 2015; Rajesh Narayan, 2015). The mixed stones were common of which the commonest combination was oxalate + phosphate + uric acid Oxalate was the common denomination for such complexes in all mixed stones indicating that perhaps oxalate was most prevalent major component 83.33%. Ammonium acid urate with uric acid were observed in 80% of mixed calculi with preponderance in the lower urinary tract calculi 91.6% (Robertson and Peacock, 1983; Elliot, 1973).

Conclusion

90 Urinary calculi analyzed by qualitative 'Spot Test' for chemical composition in terms of radicals. Majority of the urinary calculi were in third and fourth decades of their life with male predominance in the ratio of 2:1 majority of the stones were oval, grey colored uneven with the hardness of 2-3 Moh's scale. Chemical analysis revealed that 53.33% of stones were mixed. Amongst pure variety oxalate was commonest 30%. The commonest mixed stones were oxalate+ phosphate + uric acid 20%. Robertson and Peacock,1983 showed that risk of calcium oxalate crystallization was related to the following factors(in order of importance): calcium oxalate crystallization increased as urinary concentrations of oxalate, uric acid, pH and calcium increased ;it decreased as urinary concentrations of protein inhibitors and total volume increased. Using Winer and Mattice's spot testing investigator can determine very precisely the composition of almost all urinary calculi without expensive instruments. Cysteine calcium carbonate and fibrin was not encountered in this series. Many type of analysis of urinary calculi have been proposed. The most common and the most practical type for the clinical laboratory is chemical analysis. Chemical qualitative "Spot test "were best for practical use in hospital laboratory with only 2% error in detection of components of the calculi. The limitation and shortcomings of chemical spot test are

- Method is destructive
- Confusion regarding the exact nature of reaction which takes place in qualitative test
- Only atoms and groups of atoms are identified (Schmucki and Asper, 1986).

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