STONE COMPOSITION PATTERN OF KIDNEY STONE

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ABSTRACT

Objective: *The purpose of this study was to know the bacterial and sensitivity pattern towards antimicrobials on kidney stones and to know the stone composition of kidney stones.* ***Material &Method:*** *Data were collected from medical record in 1 year period from January until Desember 2008 with descriptive study design.* ***Results:*** *We found 59 patients in that period, 32 males and 27 females, the mean age was 52,5 ± 10,31 with age 31 – 75 years old, most patients came from Bantul (16,9%) and 25,4% patients were housewives. From urine analysis we found leucocyturia (44,1%), erythrocyturia (39,0%), nitrituria (3,4%) and bacteriuria (6,8%). Urine culture showed E. coli (12,5%) and Candida (12,5%) being the most common causative microorganism. No antimicrobials was sensitive to all bacteriae while all antifungal was sensitive to candida. Stone composition showed ammonium (98%), calcium oxalate (91,8%), calcium non oxalate (93,9%), carbonate (22,4%), cholesterol (14,3%), uric acid (10,2%) and phosphate acid (10,2%).* ***Conclusion:*** *The most common stone composition were ammonium, calcium oxalate, and calcium non oxalate. E. coli still being the most common causative microorganism.*

Keywords: *Kidney stone, stone composition, urinary tract infection, urine analysis, urine culture.*

ABSTRAK

Tujuan Penelitian: *Tujuan dari penelitian ini adalah untuk mengetahui komposisi kimia batu, dan untuk mengetahui pola kuman dan sensitivitas antibiotik yang diisolasi dari urine.* ***Bahan & Cara:*** *Metode penelitian retrospektif yang dianalisis secara deskriptif. Data diambil dari rekam medis pasien rawat inap di Bagian Urologi RSUP Dr. Sardjito Jogyakarta selama tahun 2008. Data diolah dengan menggunakan SPSS 13.0.* ***Hasil Penelitian:*** *Kami menemukan 59 pasien pada kurun waktu tersebut, 32 pria dan 27 wanita, dengan rerata umur adalah 52,5 10,31 dan rentang umur 31–75 tahun, pasien terbanyak berasal dari Bantul (16,9%) dan 25,4% pasien merupakan ibu rumah tangga. Dari analisis urine kami menemukan leukosituria (44,1%), eritrosituria (39,0%), nitrituria (3,4%) and bakteriuria (6,8%). Kultur urine memperlihatkan E. coli (12,5%) dan Candida (12,5%) merupakan mikroorganisme terbanyak. Tidak ada antimikroba yang sensitif terhadap seluruh bakteria, sementara seluruh anti jamur sensitif terhadap Candida. Komposisi batu memperlihatkan amonium (98%), kalsium oksalat (91,8%), kalsium non oksalat (93,9%), karbonat (22,4%), kolesterol (14,3%), asam urat (10,2%) dan asam fosfat (10,2%).* ***Simpulan:*** *Komposisi batu terbanyak adalah amonium, calcium oxalat, calcium non oxalate dan E. coli masih merupakan penyebab terbanyak infeksi saluran kencing.*

Kata Kunci: *Batu ginjal, komposisi batu, infeksi saluran kencing, analisis urine, kultur urine.*

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INTRODUCTION

Urinary tract infection (UTI) and urosepsis are complications that can arise before or after the treatment of kidney stones. Frequently, the stones are a source of infection, both infectious and non-infectious stone. Factors that could be used to predict urosepsis are the condition of the patient, urinary tract infection and history of recurrent infection, stone characteristics, and the anatomy of urinary tract.[1]

Urinary tract stones (UTS) is the most common urological disorder suffered by humans. This health problem is the oldest known to attack humans. Scientists found evidence that kidney stones have existed in an old Egyptian mummy from

over 7000 years ago.[2]

The peak age of stone incidence is in the age range of 20-50 years. Men are known to be affected three times more often than women. Factors of geography, climate and weather have a relationship in stone formation, where the kidney stones are more common in a warm climate. Low water intake may be a predisposing factor of stone formation. A diet high in animal protein increases the risk of stone formation. A diet high in salt causes hypercalciuria. The work that does not require a lot of movement also increases the risk of stone.[3]

The exact cause of the UTS is not known, because many factors are involved. Presumably there are two processes involved in the UTS, the supersaturation and nucleation. Urinary tract stones in general, contain elements of calcium oxalate or calcium phosphate, uric acid, magnesium ammonium phosphate (MAP), xanthine and cystine. UTS has the basic components of calcium about 75% of calcium oxalate, calcium phosphate or a mixture of oxalate and phosphate. UTS identification can be done by stone analysis, so the type and composition of the stone can be identified.

Urinary tract stones can develop as a result of urinary tract infections. Infection stones are present only when there is infection in the urinary tract.

The history of this type of infection stones is very interesting. The first description of this infection stones (struvite) was found in a Hungarian cemetery from bronze age.[4] In early 1797, Wollaston described UTS components as magnesium ammonium phosphate in publication entitled 'On gouty and urinary concretions'.[5]

Stone infection or struvite is the most dangerous stone disease because it has the potential of life-threatening complications. These stones have the composition of magnesium ammonium phosphate and/or carbonate apatite that comprise 15-20% of UTS.[6]

Brown is the first who put forward the theory of urea splitting bacteria that subsequently cause and facilitate stone formation. Brown was also the first to isolate Proteus vulgaris from the stone core, which is now known to produce urease.[7]

Although there is reported correlation between urinary tract infection and stone formation, not only these factors that are involved. Many patients with chronic pyelonephritis do not suffer from kidney stones, or stones present only in the kidney. Furthermore, many UTS did not reveal any infection.[8]

Urinary tract infection (UTI) is an infection caused by a proliferation of microorganisms in the urinary tract, which under normal circumstances the urine contains no bacteria, viruses or other microorganisms. Thus, the urine within the urinary tract system is usually sterile. Nevertheless, the distal end of the urethra can be inhabited by bacteria whose number was reduced in proximal urethra.

Urinary tract infections can be caused by various microorganisms, mostly are bacteria. Other causes, which are rarely found, are fungi, viruses, chlamydia, parasites, and microbacterium. Based on the results of urine culture examination, most UTIs are caused by gram-negative aerobic bacteria that are usually found in the digestive tract (Entero-bacteriaceae) and rarely caused by anareobic bacteria.

It is suggested that bacteriuria is remarkable if pathogenic bacteria are found more or equal to 100,000 per ml of middle portion urine. The presence of bacteriuria is the definite diagnosis of UTI, although it is not always accompanied by clinical symptoms.

Antimicrobial sensitivity patterns of bacteria and UTI-causing germs pattern will be instrumental in the successful treatment of UTI. By identifying them, we will be able to choose how and which antimicrobials that should be used in the treatment of UTI.

OBJECTIVE

To identify the bacteriology of urinary tract infections associated with kidney stones, to identify chemical composition of stones, and to determine antibiotic sensitivity patterns of bacteria isolated from urine.

MATERIAL & METHOD

Data were retrieved from medical records of patients hospitalized in the Urology Department, Sardjito Hospital, Yogyakarta in 2008. The method used was retrospective study with descriptive analysis. Data were processed using SPSS 13.0.

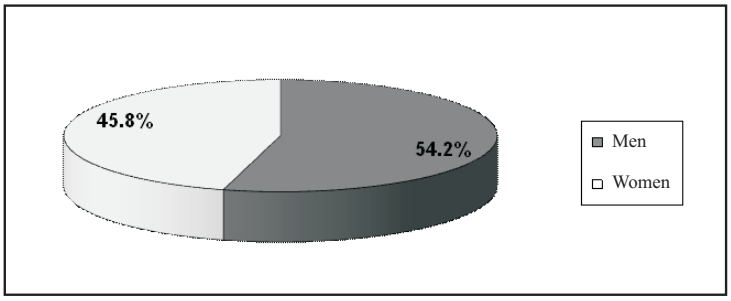
RESULTS

By 2008 there were 59 patients with kidney stones hospitalized in the urology ward Sardjito Hospital Yogyakarta, with 32 (54,2%) men and 27

(45,8%) women, mean age was 52,5 ± 10,31 with the youngest age range of 31 and the oldest 75 years. Most patients came from Bantul Yogyakarta province (16,9%) and most jobs are housewives as much as 25,4% (table 1, table 2, table 3 and graphic 1).

Table 1. Distribution of patients by sex and age.

Age	Sex		Total
	Men	Women	
30 – 39	3	2	5 (8,5%)
40 – 49	15	9	24 (40,7)
50 – 59	5	9	14 (23,7%)
60 – 69	6	6	12 (20,3%)
≥ 70	3	1	4 (6,8%)
Total	32 (54,2%)	27 (45,8%)	59 (100%)



Graphic 1. Distribution of patients by sex and age.

Table 2. Distribution of patients based on address.

Address	Frequency	Percentage (%)
Kodya DIY	8	13,6
Bantul	13	22
Gunung Kidul	3	5,1
Magelang	4	6,8
Kebumen	1	1,7
Banyumas	2	3,4
Cilacap	5	8,5
Purbalingga	1	1,7
Boyolali	1	1,7
Sukoharjo	1	1,7
Kudus	1	1,7
Kulonprogo	3	5,1
Wonosobo	2	3,4
Sleman	8	13,6
Purworejo	3	5,1
Ngawi	1	1,7
Magetan	1	1,7
Outside Java	1	1,7
Total	59	100

Urinalysis found leucocytes in urine sediment of 44%, 39% with erythrocytes and bacteria are also found in 6,8% 3,4% nitrite as indicating the activity of urea splitting bacteria (table 4).

Table 5 showed stone composition, indicating that most of stones consisted of ammonium, which was found in 98% of the samples, followed by non-calcium oxalates in 93,9%, calcium oxalates in 91,8%, uric acid and phosphoric acid in 10,2%, and cholesterol in 14,3% of the samples. We did not found xanthine nor cystine.

Forty-two patients underwent urine culture and E. coli and Candida were found in 2 (4,7%) urine culture results, followed by Pseudomonas aeroginosa. Coagulase negative Staphylococcus was found in 1 sample (2,3%) and 35 (83,3%) cultured urine samples did not reveal the growth of bacteria cultures (table 6).

Table 3. Distribution of patients based on occupation

Occupation	Frequency	Percentage (%)
Labor	5	8,5
Retired	7	11,9
Farmer	8	13,6
Private employees	9	15,3
Civil servants	13	22,0
Housewife	17	28,8
Total	59	100

Table 4. Urinalysis results.

Urine Sediment	Results	
	Positive (%)	Negative (%)
Leucocyte	44,1	28,8
Erythrocyte	39	33,9
Urine nitrite	3,4	69,5
Bacteria	6,8	66,1

Table 5. Stone analysis results.

Types of Chemicals	Results	
	Positive (%)	Negative (%)
Ammonium	98	2
Carbonate	22,4	77,6
Ca Oxalate	91,8	8,2
Ca non Oxalate	93,9	6,1
Phosphoric acid	10,2	89,8
Uric acid	10,2	89,8
Xanthine	0	100
Cystine	0	100
Cholesterol	14,3	85,7

Table 6. Distribution of microbes in urine culture results.

Microbe	Results	
	Frequensi	Percentage
E.coli	2	4,7%
Klebsiela pneumoniae	1	2,3%
Pseudomonas aeroginosa	1	2,3%
Staph coagulase negatif	1	2,3%
Candida	2	4,7%
None	35	83,3%
Total	42	100%

Table7. Patterns and sensitivity microbe against antibiotics.

No	Microbe / Antibiotics	*E. coli*		*Klebsiella pneumoniae*		*Pseudomonas areoginosa*		*Staph coagulase negative*		*Candida*	
		S (%)	R (%)	S (%)	R (%)	S (%)	R (%)	S (%)	R (%)	S (%)	R (%)
1.	Amikacin	100	-	-	-	-	100	-	-	-	-
2.	Amoxycillin	-	-	-	100	100	-	-	100	-	-
3.	Amoxycillin + clavulanic acid	100	-	-	-	-	100	-	-	-	-
4.	Ampicillin	-	100	-	-	-	-	100	-	-	-
5.	Cefoperazone	100	-	-	-	100	-	-	100	-	-
6.	Ceftazidime	-	100	-	100	100	-	-	100	-	-
7.	Ceftriaxone	50	50	100	-	100	-	-	100	-	
8.	Chloramphenicol	100	-	-	-	100	-	-	-	-	-
9.	Ciprofloxacin	-	100	-	-	100	-	-	100	-	-
10.	Cotrimoxazole	-	100	100	-	-	100	-	100	-	-
11.	Dibekacin	-	-	-	-	-	-	-	-	-	-
12.	Fosfomycin	100	-	100	-	-	100	100	-	-	-
13.	Gentamicin	50	50	-	100	-	100	-	-	-	-
14.	Meropenem	100	-	-	-	-	-	100	-	-	-
15.	Nitrofurantoin	100	-	100	-	-	100	100	-	-	-
16.	Penicillin G	-	-	-	-	-	-	-	100	-	-
17.	Tetracycline	50	50	-	100	-	-	-	100	-	-
18.	Tobramisin	50	50	100	-	-	100	-	-	-	-
19.	Amphotericin B	-	-	-	-	-	-	-	-	100	-
20.	Ketoconazole	-	-	-	-	-	-	-	-	100	-
21.	Myconazole	-	-	-	-	-	-	-	-	100	-
22.	Nystatin	-	-	-	-	-	-	-	-	100	-
23.	Polymixin B	-	-	-	-	-	-	-	-	100	-

Table 7 shows that sensitive antimicrobials for Escherichia coli were amikacin, amoxycillin + clavulanic acid, cefoperazone, chloramphenicol, fosfomycin, meropenem and nitrofurantoin. Whereas, the resistant ones were ampicillin, ceftazidime, ciprofloxacin and cotrimoxazole. For Klebsiella pneumonia, the still-sensitive antimicrobials were ceftriaxone, cotrimozale, fosfomycin, nitrofurantoin and tobramycin, while the resistant ones were tetracycline, gentamicin, ceftazidime and amoxycillin. Antimicrobials that were still sensitive for Pseudomonas aeruginosa were amoxycillin, cefoperazone, ceftazidime, ceftriaxone, chloramphenicol and ciprofloxacin, and resistant ones were amikacin, amoxycillin + clavulanic acid, cotrimoxazole, fosfomycin, gentamicin, nitrofurantoin, and tobramycin. For coagulse negative Staphylococcus, sensitive antimicrobials were ampicillin, fosfomycin, meropenem-resistant while the amoxycillin, cepoferazone, ceftazidime, ceftriaxone, ciprofloxacin, cotrimoxazole, penicillin and tetracycline. Candida were still sensitive to anti-fungal drugs including ampho-tericin B, polymixin B, nystatin, myconazole and ketoconazole.

DISCUSSION

By 2008 there were 59 patients with kidney stones hospitalized in the Urology Ward Sardjito Hospital Yogyakarta, with 32 (54,2%) men and 27 (45,8%) women, mean age was 52,5 ± 10,31 with the youngest age range of 31 and the oldest 75 years. Most patients came from Bantul Yogyakarta province (16,9%) and most jobs are housewives as much as 25,4%.

We were examining stone composition and we found that most of the stones consisted of ammonium, which was found in 98% of the samples, followed by non-calcium oxalates in 93,9%, calcium oxalates in 91,8%, uric acid and phosphoric acid in 10,2%, and cholesterol in 14,3% of the samples. We did not find the stones xanthine and sistine from all analyzed stones. Research conducted by Ye SJ, Yoo ES, Park YK, in the year 1995-2005 on urinary tract

stones found that calcium oxalates (56,3%) is the most widely material contained by a stone, and other content is uric acid (22,2%), calcium phosphate (11,4%), magnesium ammonium (8,2%), ammonium uric acid (1,3%) and cystine (0,6%).[9]

Forty-two patients underwent urine culture and E. coli and Candida were found in 2 (4,7%) urine culture results, followed by Pseudomonas aeruginosa. Coagulase negative Staphylococcus coagulase was found in 1 sample (2,3%) and 35 (83,3%) cultured urine samples did not reveal the growth of bacteria cultures. These results are similar to those obtained by T. Naas, Al-Agili and O. Bashir that E. coli and P. mirabilis as the most microorganisms obtained from the results of urine culture. They were found in five (9,6%) samples, while Klebsiella pneumoniae in 2 (3,8%) samples andPseudomonas aeruginosa in 1 (1,9%) sample, as well as Staphylococcus sp. in 1 (1,9%). Thirty-three (63,4%) samples showed no growth of micro-organism.[10]

Sensitive antimicrobials for Escherichia coli were amikacin, amoxycillin + clavulanic acid, cefoperazone, chloramphenicol, fosfomycin, meropenem and nitrofurantoin. Whereas, the resistant ones were ampicillin, ceftazidime, ciprofloxacin and cotrimoxazole. For Klebsiella pneumonia, the sensitive antimicrobials were ceftriaxone, cotrimozale, fosfomycin, nitrofurantoin and tobramycin, while the resistant ones were tetra-cycline, gentamicin, ceftazidime and amoxycillin. Antimicrobials that were still sensitive for Pseudo-monas aeruginosa were amoxycillin, cepoferazone, ceftazidime, ceftriaxone, chloram-phenicol and ciprofloxacin, and resistant ones were amikacin, amoxycillin + clavulanat acid, cotrimoxazole, fosfo-mycin, gentamicin, nitro-furantoin, and tobramycin. For coagulase negative Staphylo-coccus, remaining sensitive agents were ampicillin, fosfomycin, meropenem while the following showed resistance: amoxycillin, cepoferazone, ceftazidime, ceftria-xone, cipro-floxacin, cotrimoxazole, penicillin and tetracycline. Candida are still sensitive to anti-fungal drugs which were amphotericin B, polimixin B, nystatin, myconazole, and ketoconazole. These results are similar to those found by Ryu KH, Kim MK and Jeong YB that the most frequent microorganisms were E. coli (34,4%), Enterococcus (19,0%), Staphylococcus (10,2%), Pseudomonas (9,9%) and Klebsiella (9,8%), whereas the antimicrobials with still relatively high sensitivity were imipenem and amikacin, while ampicillin and ciprofloxacin were relatively low.[11] Samirah, Darwati, Windarti and Hardjoeno found E. coli (39,4%) and Klebsiella (26,3%) were the most numeorus, with amikacin as most sensitive to the microorganisms, while amoxycillin and ampicillin were resistant.[12]

CONCLUSION

The most common stone composition were ammonium, calcium oxalate, and calcium non oxalate. E. coli still being the most common causative microorganism.

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