

SENSITIVITY AND SPECIFICITY OF URINALYSIS TO DIAGNOSE UTI IN PATIENTS WITH UROLITHIASIS AT SARDJITO GENERAL HOSPITAL

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ABSTRACT

Objective: Urolithiasis could be caused by urinary tract infection (UTI). UTI in patients with urolithiasis need to be diagnose and manage as soon as possible. This study was aim to determine the diagnostic value of urinalysis examination to diagnose urinary tract infection (UTI) in patients with urolithiasis. **Material & method:** This study was an observational analytic with cross sectional study design, comparing one diagnostic tool with the gold standard tool to diagnose UTI. Total samples collected were 186 patients at Sardjito General Hospital, Yogyakarta. Urine culture and urinalysis were performed in patients with urinalysis and UTI. The results of urine culture and urinalysis were then compared by 2x2 table. **Results:** The sensitivity results on leukocyte esterase, eritrocyturia, bacteriuria, and nitrite respectively were 82.7%, 57.14%, 37.59%, and 13.53%. The specificity results on nitrite, bacteriuria, eritrocyturia, and leukocyte esterase respectively were 63.26%, 56.60%, 50.94%, and 33.96%. The highest level of accuracy was leukocyte esterase with 68.81% accuracy. **Conclusion:** This study showed that leukocyte esterase had good sensitivity with an accuracy of 68.81%. Examination of nitrite had the highest specificity compared to the other variables in urinalysis examination.

Keywords: Urinalysis, urinary tract infection, urolithiasis.

ABSTRAK

Tujuan: Batu saluran kemih dapat merupakan akibat adanya infeksi saluran kemih. infeksi saluran kemih pada pasien dengan batu saluran kemih membutuhkan penegakkan diagnosis dan tatalaksana sesegera mungkin. Penelitian ini bertujuan untuk mengetahui nilai diagnostik pemeriksaan urinalisis untuk menegakkan diagnosis infeksi saluran kemih pada pasien dengan batu saluran kemih. **Bahan & cara:** Penelitian ini adalah analitik observasional dengan pendekatan cross sectional dan membandingkan satu alat diagnostik dengan baku emasnya. Sampel yang terkumpul sebanyak 186 pasien di RSUP Dr. Sardjito, Yogyakarta. Pasien yang menderita batu saluran kemih dan infeksi saluran kemih dilakukan pemeriksaan urinalisis dan kultur urin. Hasil kultur urin kemudian dibandingkan dengan pemeriksaan urinalisis menggunakan tabel 2x2. **Hasil:** Didapatkan hasil sensitivitas pada pemeriksaan leukosit esterase, eritrosituria, bakteriuria dan nitrit berturut turut 82.7%, 57.14%, 37.59% dan 13.53%. Pada penilaian spesifisitas, pemeriksaan nitrit, bakteriuria, eritrosituria dan leukosit esterase didapatkan hasil 63.26%, 56.60%, 50.94% dan 33.96%. Tingkat akurasi tertinggi pada pemeriksaan leukosit esterase sebesar 68.81%. **Simpulan:** Hasil penelitian ini menunjukkan bahwa pemeriksaan leukosit esterase memiliki sensitivitas yang besar dengan tingkat akurasi mencapai 68.81%. Pemeriksaan nitrit memiliki tingkat spesifisitas yang besar dibandingkan dengan variabel pemeriksaan lainnya.

Kata kunci: Urinalisis, infeksi saluran kemih, batu saluran kemih.

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INTRODUCTION

Urinary Tract Infection (UTI) is a health problem commonly found; it is a typical health problem and requires special handling. However,

today the pathogenesis of stone formation has begun to be found.^{1,2}

The prevalence or frequency in the population of kidney stones in the United States has increased significantly, from 3.2-5.2% in the two

decades or between the mid-1970s until the mid-1990.¹ In Indonesia alone, from the published data, the number of patients with kidney stones who underwent actions during the period 1997 to 2002 increased from 182 patients into 847 pasien.³ Vesicolithiasis, despite being reduced in the last two decades, can still be found in some developing countries and predominantly in children, in Benign Prostatic Hypertrophy (BPH), and in patients with neurogenic bladder.¹

Important predisposing to the occurrence of Urinary Tract Infection (UTI) is an obstruction or stasis in the urinary system. In other cases, such as BPH, it is mentioned that 45% will be accompanied by UTI; urethral strictures mentioned as much as 3-8%, and urethral diverticulum, as much as 2%, will be accompanied by UTI.⁴

Nephrolithiasis may be the result of UTI. Studies have shown that some bacteria play an important role in the formation of urinary stones, especially kidney stones. A total of 15% type of urinary stones is infection.⁵ Infection process in particular is caused by urease-producing bacteria which not only produces infection stones, but also other kinds of stones such as calcium oxalate stones.⁵ It is therefore important to be able to establish the diagnosis of Urinary Tract Infection in patients of urinary stone so that treatment can be done comprehensively that starts by addressing the causes.

Urinalysis as a modality for the diagnosis of Urinary Tract Infection is one of the earliest methods and the most frequently used. This modality is simple, fairly inexpensive, fast to use and effective for identifying the presence of bacteria, urinary sediment and leukocytosis on urine.⁶ Another advantage of this method includes the use of small number of samples and can be used as a guideline for the initial assessment of the patient. Another reason for clinicians tend to use urinalysis is the gold standard examination of urine culture is longer, more complex, and more expensive.^{4,6-8}

Urinalysis examination has a sensitivity of 76% and a specificity of 86% in the diagnosis of acute kidney injury (AKI) and are able to distinguish AKI with acute tubular necrosis or ATN.⁶ However, in some studies, there are differences in the findings regarding the sensitivity and specificity of urinalysis to help enforce diagnosis.⁹

Urine culture as gold standard for the diagnosis of UTI also has disadvantages as the results of sensitivity and specificity truly depend on

the threshold of the number of colonies of germs and sampling. Examination of urine culture is recommended to be carried out during the treatment process, yet the outcome or response to treatment is less satisfying.^{4,6,7}

OBJECTIVE

This study was aim to determine the diagnostic value of urinalysis examination for diagnosis of UTI in patients with urinary tract stones.

MATERIAL & METHOD

This study is a retrospective study with cross sectional design. This study had the specific form as a diagnostic study to compare a diagnostic method with examination of gold standard.¹⁰ The independent variables in this study include the value of bacteriuria, leukocyte esterase, eritrosituria, and nitrite in the urinalysis examination and urine culture test results. The dependent variable in this study was the incidence of urinary tract infections in patients with urinary tract stones. The data obtained were analyzed using 2 x 2 tables without analysis, using Chi-Square test. Then calculation on sensitivity (SEN), specificity (SPF), positive predictive value (PPV), negative predictive value (NPV), and accuracy (ACC) would be done.

RESULTS

The subjects involved in this study were patients at the urology clinic and inpatient units at Sardjito Hospital with a total sample of 186 patients. Subjects are patients diagnosed with urinary tract stones, regardless of their stones of whether the kidney ones (nephrolithiasis), ureteral ones (ureterolithiasis), and bladder stones (vesicolithiasis), followed by UTI. UTI diagnosis was based on urine culture results.

Data on the characteristics of research subjects include age, sex, urine culture results, the type of bacteria, and the results of urinalysis including bacteriuria, eritrosituria, nitrite, and leukocyte esterase.

Table 2 shows that the parameters of leukocyte esterase had the highest sensitivity value that was equal to 82.70% followed by eritrosituria (57.14%), bacteriuria (37.59%), and nitrite (13.53%). The highest specificity was nitrite (62.26%) followed by bacteriuria 56.60%,

Table 1. Characteristics of research subjects.

Criteria		Number	Percentage
Sex	a. Male	135	72.6
	b. Female	51	27.4
Age	a. 1-20 years old	8	4.3
	b. 21-30 years old	11	5.91
	c. 31-40 years old	18	9.67
	d. 41-50 years old	47	25.26
	e. 51-60 years old	64	34.4
	f. 61-70 years old	23	12.36
	g. 71-80 years old	15	8.06
Urine culture	a. Found		
	- <i>Escherichia coli</i>	39	20.96
	- <i>Klebsiella pneumonia</i>	20	10.75
	- <i>Enterobacter cloacae</i>	23	12.36
	- <i>Burkholderia cepacia</i>	12	6.45
	- <i>Staphylococcus sp</i>	12	6.45
	- <i>Acinetobacter sp</i>	10	5.37
	- <i>Pseudomonas aeruginosa</i>	6	3.22
	- <i>Streptococcus sp.</i>	4	2.15
	- Lainnya	10	11.62
	b. Not found	48	25.8
Bacteriuria	c. Fungi	2	1.07
	a. Positive	73	39.24
Leukocyte esterase	b. Negative	113	60.76
	a. Positive	145	77.95
Eritrocyturia	b. Negative	41	22.05
	a. Positive	102	54.83
Nitrite	b. Negative	84	45.17
	a. Positive	38	20.43
	b. Negative	148	79.57

Table 2. Summary of sensitivity, specificity, positive predictive value, negative predictive value on a urinalysis to predict UTI.

Parameter	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Bacteriuria	37.59%	56.60%	68.49%	26.54%	43.01%
Leukocyte esterase	82.70%	33.96%	75.86%	43.90%	68.81%
Eritrocyturia	57.14%	50.94%	74.50%	32.14%	55.37%
Nitrite	13.53%	62.26%	47.36%	22.29%	27.41%

eritrosituria (50.94%), and leukocyte esterase (33.96%).

DISCUSSION

Urinalysis is an investigation that is very useful in the diagnosis of UTI and is widely used as a guide in providing empirical therapy in cases of UTI.

In this study, 72.6% of the patients were male. This was consistent with the data confirming that the incidence of urinary stones in males reaches 70-81% and 47-60% in female.¹¹ This was due to testosterone and estrogen factor as inhibitors of stone formation in women.

Patients in this study had varied age ranges, ranging from children aged 1 year to senior citizens

aged 80 years. The process of formation of urinary stones in children can be due to cystinuria, a congenital defect characterized by abnormalities in the metabolism of amino acids that stimulate the formation of stones cystin. The disorder was generally due to mutations in the SLC3A1 gene located on chromosome 2p21 and SLC7A9 gene located on chromosome 19q12. The existence of cases of kidney stones in children because of hereditary factors was up to 40%.^{12,13}

The cases of urinary tract stones found in old age, of more than 50 years was 34.4%, and in geriatric patients reach more than 10%.¹² Urinary tract stones will be worse if found in older patients. The severity associated with increased age, female sex, and diabetes mellitus. However, calcium oxalate stones were more common in young women. Calcium phosphate stones were found in middle age. It can be concluded that age and gender strongly influence the type of stones to be found.¹³

From the urine culture, 73.11% showed the results of Colony Forming Unit (CFU) of more than 105 per mL of urine. This showed the growth of bacteria. The type of bacteria most widely found was *E. coli* on 39 patients (20.96%), followed by *Enterobacter cloacae* on 23 patients (12.36%), *Klebsiella* sp. on 20 patients (10.75%), *Staphylococcus* sp. and *Burkholderiacepacia* each on 12 patients (6.45%), *Acinetobacter* sp. on 10 patients (5.37%), *Pseudomonas aeruginosa* on 6 patients (3.22%), *Streptococcus* sp. on 4 patients (2.15%), and other species including *Acinetobacter* sp., *Kochuria*, *Achromobacter* and *Salmonella*, each on 10 patients (11.62%). This finding supports the theory that in the case of UTI in both male and female, the most commonly found microorganism was *Escherichia coli*, up to 80%. However, *Klebsiella*, *Proteus*, *Pseudomonas*, and *Enterococcus* can also be found.^{7,14}

Among some of the parameters to predict UTI, and were assessed in the study, include leukocyte esterase, bacteriuria, eritrosituria, and nitrite. Parameters such as leukocyte esterase had the highest sensitivity value that was equal to 82.70% and a specificity value of 33.96%. The sensitivity of leukocyte esterase, which is high enough, was proportional to the positive predictive value, which can be seen from the results of comparative analysis by the urinalysis urine culture, in which 75.86% samples with positive leukocyte esterase show growth of bacteria on culture examination. The results of the examination of negative leukocyte

esterase showed no bacterial growth on culture results as much as 43.9%. It can be said that negative predictive value was 43.90% (Table 2).

The a fore-mentioned results were in accordance with previous studies which stated that the sensitivity of leukocyte esterase to diagnose UTI reaches 75-96%, but different results on the specificity that was equal to 94-98%. Examination of leukocyte esterase was useful to indicate leukosituria or pyuria at a relatively low cost.^{14,15}

Bacteriuria had a sensitivity of 37.59%, a specificity of 56.60%, 68.49% positive predictive value, and 26.54% negative predictive value. It was based on the results of positive bacteriuria that showed growth of bacteria in the culture as much as 68.49%, and the results of negative bacteriuria that did not indicate a growth of bacteria as much as 26.54%.

Parameter of eritrosituria had a sensitivity of 57.14%, a specificity of 50.94%, 74.75% positive predictive value, and 32.53% negative predictive value.

Nitrite urinalysis parameter had the lowest sensitivity of only 13.53%, but the specificity value reached 62.26%. Positive predictive value and negative predictive value of the nitrite test respectively were 47.36% and 22.29%. Nitrite test was mentioned to tend to be insensitive but relatively specific. These results showed the importance of nitrite test in cases UTI with negative culture test results.¹⁶

Nitrite test was also considered less helpful. This was because the nitrite test would only gave a positive result in bacteria that produce nitrate reductase. In the absence of this enzyme, then there would be changes of nitrate into nitrite. Some bacteria such as *Escherichiacoli*, *Klebsiella*, *Proteus*, *Enterobacter*, *Citrobacter*, and *Pseudomonas* could change nitrate into nitrite. However, UTI-causing microorganisms such as *Staphylococcus*, *Streptococcus*, *Haemophilus*, and *Enterococcus* were not able to transform nitrate into nitrite. False negative test results may result from urinate too often resulting in lower exposure of organisms to nitrate. This usually occurs in patients with low-vegetables diet and high level of vitamin C consumption. Therefore, if the urinalysis examination did not find nitrite, it did not mean that UTI did not exist.¹⁷

The results of this study based on the order of sensitivity and specificity showed that the highest sensitivity were on leukocyte esterase (76%), on eritrosituria (76%), and on nitrite (56%). The highest

specificity is on nitrite (81%), followed by eritrosituria (61%), and on leukocyte esterase (60%).¹⁸

This study produces different information with previous studies that urinalysis was not sufficiently effective as a predictive factor of UTI due to by positive and negative predictive value that was too low. This study indicates that positive predictive value for all urinalysis parameters studied both leukocyte esterase and eritrosituria exceeding 70%, while bacteriuria has a pretty good positive predictive value of 68.49%. Only nitrite had a positive predictive value of 47.36% and a negative predictive value of 22.29%.⁹

CONCLUSION

This study showed that leukocyte esterase had good sensitivity with an accuracy of 68.81%. Examination of nitrite had the highest specificity compared to the other variables in urinalysis examination.

REFERENCES

1. Moe OW. Kidney stones: pathophysiology and medical management. *Lancet*. 2006; 367: 333-44.
2. Bryant M, Angell J, Tu H, Goodman M, Pattaras J, Ogan K. Health related quality of life for stone formers. *J.Urol*. 2012; 188: 436-40.
3. Rahardjo D, Hamid R. Perkembangan penatalaksanaan batu ginjal di RSCM tahun 1997-2002. *J I Bedah Indonesia*. 2004; 32(2): 58-63
4. Heyns CF. Urinary tract infection associated with conditions causing urinary tract obstruction and stasis, excluding urinary tract stones and neuropathic bladder. *World.J.Urol*. 2012; 30: 77-83.
5. Jan H, Akbar I, Kamran H, Khan J. Frequency of renal stone disease in patients with urinary tract infection. *J.Ayub.Med.Coll.Abbottabad*; 2008. p. 60-62.
6. Perazella MA, Coca SG, Kanbay M, Brewster UC, Parikh CR. Diagnostic Value of Urinary microscopy for differential diagnosis of acute kidney injury in hospitalized patient. *Clin.J.Am.Soc. Nephrol*. 2008; 3: 1615-9.
7. Harper M, Fowles G. Management of urinary tract infections in men. *Trends in Urology Gynaecology dan Sexual Health*; 2007. p. 30-35. Available at <http://onlinelibrary.wiley.com/doi/10.1002/tre.8/pdf>
8. Gibson K, Toscano J. Urinary tract infection update. *Am.J.Clin.Med*. 2012; 9(2): 82-86.
9. Nostrand JDV, Alan MS, Junkins Bartholdi RK. Poor Predictive Ability of Urinalysis and Microscopic Examination to Detect Urinary Tract Infection. *Am J Clin Pathol*. 2000; 113: 709-13.
10. Dahlan MS. Penelitian diagnostik: Dasar-dasar teoritis dan aplikasi dengan program SPSS dan Stata. Jakarta: Salemba Medika; 2009.
11. Vijaya T, Kumar MS, Ramarao NV, Babu AN, Ramarao N. Batu saluran kemih and Its Causes-Short Review. *J. Phytopharmacol*. 2013; 2(3): 1-6.
12. Arampatzis S, Lindner G, Irmak F, Funk GC, Zimmermann H, Exadaktylos AK. Geriatric batu saluran kemih in the emergency department: risk factors for hospitalisation and emergency management patterns of acute batu saluran kemih. *BMC Nephrology*. 2012; 13: 117.
13. Kohri K, Ishikawa Y, Katoh Y, Kataoka K, Iguchi M, Yachiku S, et al. Epidemiology of urinary tract stones in the elderly. *Int Urol Nephrol*. 1991; 23(5): 413-21.
14. Gradwohl SE, Bettcher CM, Chenoweth CE, Harrison R, Zoschnick LN. Urinary Tract Infection Guideline. *UMHS*; 2011.
15. Schulz T, Machado MJ, Treitinger A, Flamoncini A, Niederauer LMO. 2014. Risk associated with dipstick urinalysis for diagnosing urinary tract infection. *Pinnacle Biochem.Res*. 2014; 1(1): 1-6.
16. Santos JC, Weber LP, Perez LRR. Evaluation of Urinalysis Parameters to Predict Urinary-Tract Infection. *Brazilian J. Infectious Diseases*. 2007; 11(5): 479-81.
17. Lerma EV. Urinalysis. In: *Medscape: Drug and Diseases*; 2015. Available at: <http://emedicine.medscape.com/article/2074001-overview>
18. Othman S, Chia YC, Jenn C. Accuracy of urinalysis in detection of urinary tract infection in a primary care setting. *Asia Pacific Family Medicine*. 2003; 2: 206-12.