DIAGNOSTIC VALUE OF NON-CONTRAST HELICAL CT SCAN AND INTRAVENOUS UROGRAPHY IN UROLITHIASIS EVALUATION

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ABSTRACT

Objective: *To evaluate the diagnostic value of Non Contrast Helical Computed Tomography (NCHCT) scanning as the first choice diagnostic modality for detecting urolithiasis cases in Soetomo General Hospital Surabaya and evaluate the feasibility as alternative to Intravenous Urography (IVU).* ***Material & Methods:*** *Seventeen patients with clinical manifestation of suspected urolithiasis underwent NCHCT and IVU to evaluate suspected urolithiasis. Reformatted three-dimensional CT was performed in all patients. The images were correlated with findings from surgical procedure (ureteroscopy, percutaneous nephrolithotomy, and open surgery). Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were determined for NCHCT and IVU.* ***Results:*** *The diagnosis of urolithiasis was defined as unequivocal evidence of urolithiasis on either NCHCT or IVU. Sixteen of seventeen patients evaluated were diagnosed with urolithiasis. NCHCT established the diagnosis in 16 of 17 patients while IVU was positive in 11 of 17 patients. IVU was negative in 6 of the 17 cases. The sensitivity, specificity and accuracy of NCHCT was 100%, 100%, and 100% respectively (p = 0.05) and the sensitivity, specificity, and accuracy of IVU was 68%, 100% and 70% respectively (p = 0.35). There was no statistically significant difference between IVU and NCHCT using Fisher's exact test.* ***Conclusions:*** *NCHCT accurately diagnosed urolithiasis in patients with suspected urolithiasis. Considering that NCHCT is more effective and efficient than IVU as diagnostic modality in determining the presence of urolithiasis, it may be considered to replace IVU as the first line diagnostic tool for urolithiasis in Soetomo General Hospital Surabaya.*

Keywords: *Non Contrast Helical CT Scan, Intravenous Urography, Urolithiasis.*

ABSTRAK

Tujuan: *Mengevaluasi nilai diagnostik pemindaian Non-Contrast Helical Computed Tomography (NCHCT) sebagai modalitas utama dalam diagnosis batu saluran kencing di RSUD Dr. Soetomo Surabaya serta mengevaluasi kelayakan NCHCT sebagai alternatif Intravenous Urography (IVU) sebagai alat diagnostik batu saluran kencing.* ***Bahan & cara:*** *Tujuh belas pasien dengan keluhan dan klinis dicurigai menderita batu saluran kemih menjalani pemeriksaan NCHCT dan IVU. Hasil NCHCT dan IVU dibandingkan dengan hasil temuan batu saat tindakan operasi (ureteroscopy, percutaneous nephrolithotomy atau pembedahan terbuka). Kemudian ditentukan sensitivitas, spesifisitas, nilai prediksi positif, nilai prediksi negatif dan akurasi NCHCT dan IVU.* ***Hasil:*** *Dari 17 sampel, 16 terdiagnosa batu saluran kemih. NCHCT dapat menegakkan diagnosis pada 16 dari 17 pasien, dan IVU mendiagnosis 11 dari 17 pasien. Sensitivitas, spesifisitas, dan akurasi NCHCT adalah 100%, 100%, dan 100% berturut-turut (p = 0.05). Sensitivitas, spesifisitas, dan akurasi IVU adalah 68%, 100%, dan 70% berturut-turut (p = 0.35). Dengan menggunakan Fisher's exact test, tidak didapatkan perbedaan yang bermakna secara statistik antara NCHCT dibandingkan dengan IVP.* ***Simpulan:*** *NCHCT dapat mendiagnosa batu saluran kemih dengan akurat pada pasien yang dicurigai menderita batu saluran kemih. NCHCT lebih efektif dan lebih efisien dibandingkan IVU sebagai modalitas diagnosa batu saluran kemih dan sebaiknya NCHCT menggantikan IVU sebagai alat diagnosis utama batu saluran kemih di RSUD Dr. Soetomo Surabaya.*

Kata kunci: *Non-Contrast Helical CT Scan, intravenous urography, batu saluran kemih.*

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INTRODUCTION

Urolithiasis is an important health issue. The prevalence of urolithiasis varies according to age, sex, geographic location where 4 out 5 patients are men, peaking in third and fourth decade.[1] In the United States of America urolithiasis is the third most common disease of the urinary tract after infection and prostate disease,[2] with annual increases in prevalence. In 2000 incidence of urolithiasis had reached 116 per 100.000 population,[3] where kidney stone itself accounted for 1-15% of all urolithiasis cases.[1] Generally the prevalence of urolithiasis today is 10-15%.[1] In 2002, the incidence of urolithiasis in Indonesia based on data compiled from hospitals all over Indonesia is 37.636 new cases, with 58.959 outpatient visits and 19.018 patients are followed up, with 378 mortality events.[4]

Rochani et al, in 2007 reported that urolithiasis was recorded as the most frequent primary diagnosis in hospital outpatient visit.[5] Published local data showed an increase of urolithiasis in patients at Cipto Mangunkusumo General Hospital every year, in 1997 there were 182 patients increasing in 2002 to 847.[5] At our outpatient department, urolithiasis is the most frequent diagnosis, with 4.212 cases out of 9.409 cases between 2003 to 2007. Urolithiasis showed increasing annual incidence where in 2003 there were 189 of 592 all urology cases and the latest report in 2007, urolithiasis still stands as the major disease accounting for 863 cases of 1.811 all urology cases. Prevalence of urolithiasis in Soetomo General Hospital is 48% of all diseases in urology.[6]

Urolithiasis diagnosis is made by symptoms of colic, flank pain, hematuria, nausea and vomiting,[2] and often came in septic condition.[7] Ancillary examinations are complete blood count, urinalysis and imaging. Appropriate imaging modalities are KUB, ultrasound and intravenous urography.[2,7]

Stone opacity is different from one type to another, depending on the mineral content of the stone.[8,9] Ultrasound can confirm stones in kidney, proximal and distal ureter as well as bladder.[8] Recently the gold standard for urolithiasis diagnosis is Non Contrast Helical Computed Tomography (NCHCT).[10,11] Many studies have explained how NCHCT especially the latest generation of CT Scan (multi slice CT Scan) is superior than any others,[12,13] because NCHCT has the ability to differentiate stones from other abnormalities in urinary tract such as blood clot, and malignancy.[11,14]

Today in Indonesia, IVU is still the most frequent examination for urolithiasis and NCHCT has not yet used anywhere as a primary diagnostic tool for patients in suspicion urolithiasis.

OBJECTIVE

The purpose of this prospective study is to evaluate the diagnostic value of NCHCT as the first choice diagnostic modality for detecting urolithiasis cases in Soetomo General Hospital Surabaya and evaluate the feasibility of replacing IVU.

MATERIAL & METHOD

The study was performed in May until August 2013, patients who came to Urology Outpatient Department, Minimal Invasive Urology Unit and Emergency Ward of Soetomo General Hospital Surabaya with complaints of flank pain, colic, or history of stone expulsion. After the patients were given the information and signed in, their blood were drawn (Haemoglobin, ureum, and creatinin), if normal then they were included. While patients with abnormal creatinine level, history of contrast allergy, pregnant, and diabetic were excluded from the study. All patients underwent NCHCT and IVU.

All patients who met the inclusion criteria underwent NCHCT using multislice CT Scan (Toshiba Multislice X-Ray CT Scanner Activion TM16) from level of kidneys to pubic symphysis in emergency ward of Soetomo General Hospital Surabaya.

IVU was performed after NCHCT, with plain abdominal film and continued with contrast injection (Iopamiro 370), 1 cc/kg of weigh body intravenously. Bowel preparation with 10 mg Bisacodyl was done one day before the procedure.

The analysis was using crosssectional diagnostic study. Analysis using 2 x 2 table, followed with sequence analysis with sequence model result. Using 2 x 2 table, the outcomes are sensitivity, specificity, positive predictive value, negative predictive value and accuracy.

RESULTS

A total of 17 patients were included in this study. Study population was male majority over women with ratio of 2 : 1 (11 men and 6 women),

Table 1. Sample characteristics.

Study Characteristics	Sum	Min	Max	Mean	Standar Deviasi
Age (year)	17	23	70	46.76	12.666
Sex					
Male	11	-	-	-	-
Female	6	-	-	-	-
Laboratory					
Hb	17	9.60	16.70	13.60	2.101
Leukosit	17	4.80	22.50	9.01	3.697
BUN	17	7.00	18.00	11.64	3.070
Kreatinin	17	0.42	1.40	1.06	0.280
Urine culture					
Positive	5	-	-	-	-
Negative	12	-	-	-	-
Non Contrast CT Scan					
Positive	16	-	-	-	-
Negative	1	-	-	-	-
Intravenous Urography					
Positive	12	-	-	-	-
Negative	5	-	-	-	-

Table2. Patients characteristics.

Characteristics	Frek	%	% Cumulative
Complaint			
Haematuria	1	5.9	5.9
Colik	1	5.9	11.8
Abdominal pain	1	5.9	17.6
Flank pain	14	82.3	100
NCCT and IVU			
Ureter stone	8	47.05	40.05
Pyelum stone	4	23.5	70.55
Staghorn stone	4	23.5	95.05
Ureter stenose	1	5.8	100
Surgical Procedure			
Biv. Nephrolithotomy	1	5.9	5.9
Pyelolithotomy	4	23.5	29.4
PCNL	4	23.5	52.9
URS	8	47.1	100

mean age 46.76 years old (± 12.66). Twelve (70.6%) patients had negative urine culture, only 5 (29.4%) with positive culture. Blood leucocyte, hemoglobin, and creatinine serum were normal.

Most patients came with chief complaint of flank pain (14 patients) then followed by colic, haematuria, and abdominal pain (1 patient each). From the result of NCHCT and IVU confirmed with surgical procedure most suffered from ureter stone (8 patients) followed by pyelum stone (4 patients) and staghorn stones (4 patients). From the surgical procedure URS is the most frequent procedure (8 patients), then followed by Pyelolithotomy (4 patients) and PCNL (4 patients), only 1 patient was performed bivalve nephrolithotomy.

IVU found 11 patients with urolithiasis and 6 patients no urolithiasis. Confirmed by surgical procedure 16 patients was found with urolithiasis.

IVU had sensitivity and specificity of 68.75% and 100%, positive and negative predictive value 100% with accuracy 70% (p=0.35).

Table 3. Diagnostic value of IVU for urolithiasis.

		Surgical Finding		
		(+)	(-)	Total
IVU	(+)	11	0	11
	(-)	5	1	6
Total		16	1	17

Table 4. Diagnostic value for urolithiasis.

		Surgical Finding		
		(+)	(-)	Total
NCCT	(+)	16	0	16
	(-)	0	1	1
Total		16	16	1

NCHCT found 16 patients with urolithiasis and 1 patient negative. Sensitivity and specificity of NCHCT was both 100%, positive, negative predictive value and accuracy 100% (p = 0.05).

DISCUSSION

This study showed diagnostic value of NCHCT and IVU for urolithiasis. The purpose was to obtain sensitivity, specificity, positive predictive, negative predictive values, and accuracy of both diagnostic modalities.

NCHCT is a suitable diagnostic test for urinary stone disease, because NCHCT is non invasive, need no preparation, shorter examination time, can be done to all patients with suspicion of urolithiasis without considering kidney function, and possible for multiplanar 3 dimension reconstruction.[15]

In the study, IVU compared to surgical findings showed 68.75% sensitivity, 100% specificity, with positive predictive value, negative predictive value, and accuracy are 100%, 16.6%, and 70% respectively, with p value = 0.35. Viewing the (p) value the study has showed that IVU was less significant. Based on reviewed studies, this result is quite similar to reports by Bario et al in 2004 who explained sensitivity and spesificity of IVU to diagnose urolithiasis is 64-92%.[16]

Sensitivity and specificity of NCHCT in the study is each 100%, with positive predictive value of 100%, negative predictive value of 100%, 100% accuracy, p value = 0.05. On IVU, urolithiasis is found by filling defect feature and obstructive images showed by the contrast filling urinary tract. The examination is limited by renal function test.[8]

A study conducted by Saita et al in 1987 reported that IVU had 84% sensitivity value and specificity of 85%.[17] Another study performed by Sinclair et al in 1989 showed that IVU had 90% sensitivity and 94% specificity.[18] Svenstrom et al in 1990 reported sensitivity and specificity of IVU combined with ultrasound is 93% and 79%.[8]

CT Stonogram is a type of CT examinations to diagnose urinary stone disease. Compared to other diagnostic tools using X ray and contrast injection, CT Stonogram is more accurate to identify the measure and location of almost all types of urinary stone. CT Stonogram is a painless procedure and does not need contrast injection.[20] With CT Stonogram the diagnosis is made faster, more accurate, and the abdomen is visualized even better. Other benefits of CT Stonogram are, besides no specific preparations needed, it can identify small stones that may be undetectable on other conventional radiologic examinations, no need for renal function test, able to detect other abnormality in urinary tract, may be viewed in three dimensions, provides positional estimation, stone composition.[15,21]

Zagoria explained NCHCT is better to detect urolithiasis than other imaging such as KUB, conventional tomography, ultrasound, even IVU. A study performed in 1998 showed that NCHCT was the gold standart in diagnosis of urolithiasis. IVU had sensitivity of 50-70%, while NCHCT showed better sensitivity and specificity of 97% and 96%, 96% accuracy, with positive predictive value of 97%, and negative predictive value of 98%. NCHCT is unable to provide kidney function information but NCHCT provides better information of stone form and location than IVU.[12]

Usage of NCHCT is indicated because it is easy and fast, provides other information of other diseases.[16] NCHCT is able to detect all kinds of stone, radioopaque and radiolucent.[22] Bariol also reported IVU has limitation due to contrast toxicity, longer time needed for examination, also complicated and uncomfortable preparations have to made by the patients.[16]

Several conditions may increase the risk of allergic reaction due to IVU, such as age (children and elderly are more prone to have allergic reaction),

Table 5. Comparison of diagnostic value of imaging modalities for urolithiasis from published literature.

Study	n	Radiologic Evaluation			Control Group	
		Sensitivity	Specificity		Sensitivity	Specificity
KUB						
Levin et al	151	59	71	IVU	-	-
Svedstrom et al	49	53	74	IVU	87	100
Mutgi et al	85	58	69	IVU	95	-
Ultrasound						
Kuuliala et al	59	81	92	IVU	-	-
Saita et al	157	82	-	IVU	84	-
Sinclair et al	85	85	100	IVU	90	94
Juul et al	102	94	-	IVU	88	-
Haddad et al	101	91	90	IVU	-	-
Hill et al	61	66	100	IVU	85	100
NCCT						
Smith et al	210	97	96	IVU	-	-
Fielding et al	100	98	100	IVU	-	-
Miller et al	106	96	100	IVU	88	94
Current Study	17	100	100	IVU	68	100

sex (women are more often than men), other comorbid disease (ashtma, heart and cardiovascular disease, diabetes, dehydration), hematologic disease (myeloma, sickle cell anemia, polycythemia), history of drugs consumption (NSAIDs, beta blockers, biguanide, IL-2). Injection technique may play a role in adverse reactions including too rapid injection or intraarterial entry.[24]

Although very rare, CT Stonogram may give false negative result because of radiographer's misinterpretation or protease-inhibitor CT-lucent stone. False positive result in NCHCT may also occur, usually with phleboliths around ureter that is reported as stones. In some cases, after CT Stonogram, intravenous contrast injection is needed to rule out urolithiasis from phleboliths.[25]

In reviewing cost effectivenes, NCCT 50% is higher than IVU. The cost of NCHCT may vary depending on each institution, but NCHCT is more recommended considering the benefits.[20]

CONCLUSION

NCHCT is shown as the best diagnostic tool to diagnose patients with suspicion of urolithiasis. NCHCT may replace IVU in this matter.

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