CORRELATION BETWEEN S.T.O.N.E NEPHROLITHOMETRY SCORING IN PREDICTING FREE-STONE RATE AFTER PERCUTANEOUS NEPHROLITHOTOMY

[1]Karinda Triharyu Caesari Putri, [1]Fikri Rizaldi, [1]Tarmono Djojodimedjo, [1]Sunaryo Hardjowijoto.

[1]Department of Urology, Faculty of Medicine/Universitas Airlangga, Soetomo General Hospital, Surabaya.

ABSTRACT

Objective: *To investigate free-stone rate after Percutaneous Nephrolithotomy (PNL) using S.T.O.N.E nephrolitometry scoring system, with regards of stone size (S), skin-to-stone distance (T), obstruction degree (O), number of calyx involved (N), and stone density (E) in Non Contrast CT Scan (NCCT).* ***Material & methods:*** *This is an analytic observational study on patients with renal stones undergoing PNL. All patients underwent NCCT before and after PNL; each variables was measured and counted for a total score. Post-operative evaluation was done using NCCT.* ***Results:*** *Thirty patients met inclusion criteria, 19 (63.3%) were stone-free, and 11 (36.7%) were with residual stone. Among the five variables, stone size (p=0.005), number of calyx involved (p=0.002) affected the outcome of surgery, while skin-to-stone distance, obstruction degree, and stone density did not. The overall total score of S.T.O.N.E nephrolithometry is correlated with the outcome of PNL (p=0.001).* ***Conclusion:*** *S.T.O.N.E nephrolithometry is a simple scoring system, while it is also easy to use, and can be used to predict the free-stone rate after PNL.*

Keywords: *Percutaneous nephrolithotomy, scoring system, renal stone, non contrast CT Scan.*

ABSTRAK

Tujuan: *Untuk mengetahui angka bebas batu paska percutaneous nephrolitotomy (PNL) menggunakan sistem skor S.T.O.N.E nephrolitometry dengan menilai ukuran batu (S), jarak batu ke kulit (T), derajat obstruksi (O), jumlah kaliks terlibat (N), dan densitas batu (E) pada Non Contrast CT Scan (NCCT).* ***Bahan & cara:*** *Penelitian ini adalah penelitian prospektif observasional analitik pada pasien batu ginjal yang menjalani PNL. Semua pasien diperiksakan NCCT pada sebelum dan sesudah prosedur PNL, masing-masing variabel dinilai dan dihitung skor keseluruhannya. Hasil operasi dievaluasi dari NCCT paska operasi.* ***Hasil:*** *Sebanyak 30 pasien masuk ke dalam kriteria inklusi, 19 pasien (63.3%) dengan hasil operasi batu bersih, dan 11 pasien (36.7%) masih ada sisa. Diantara kelima variabel didapatkan ukuran batu (p=0.005), jumlah kaliks terlibat (p=0.002) mempengaruhi hasil operasi, sedangkan jarak batu ke kulit, derajat obstruksi, dan densitas batu tidak berhubungan. Hasil skor S.T.O.N.E nephrolithometry berhubungan terhadap hasil operasi PNL (p=0.001).* ***Simpulan:*** *S.T.O.N.E nephrolithometry merupakan sistem skoring yang sederhana, mudah dipakai serta dapat digunakan untuk memprediksi angka bebas batu paska PNL.*

Kata kunci: *Percutaneous nephrolithotomy, sistem skor, batu ginjal, Non Contrast CT Scan.*

Correspondence: Karinda Triharyu Caesari Putri; c/o: Department of Urology, Faculty of Medicine/Universitas Airlangga, Soetomo General Hospital, Surabaya. Jl. Mayjen. Prof. Dr. Moestopo 6-8 Surabaya 60286. Phone: +62 31 5501318; Fax: +62 31 5024971. Mobile phone: 081331644637. Email: ayu_karinda@yahoo.co.id.

INTRODUCTION

Urolithiasis is the third most common disease of the urinary tract.[1] Data from Soetomo General Hospital from 2007-2012 shows that urolithiasis is the most frequent case found in outpatient clinic as well as in Urology ward.[2] Advances in technology and surgical techniques has allowed a continuous evolution of Percutaneous Nephrolithotomy (PNL), making this procedure more efficient and better than other procedures in the management of urolithiasis, particularly renal stones.[3]

Varied reports regarding the outcome of PNL have raised the need of a prognostic tool to predict the success rate of this procedure in a scoring system. S.T.O.N.E nephrolithometry scoring system was first introduced by Okhunov and colleagues in

2013 and based on five variables measured by pre-operative Non Contrast Computed Tomography (NCCT). Those five variables were shortened into an acronym "S.T.O.N.E" which stands for Size = stone size (mm^2), Track Length = stone-to-skin distance (mm), Obstruction = existence of obstruction caused by stone, Number of involved calices, Density = stone density (HU).

Noureldin et al conducted a study which showed that S.T.O.N.E nephrolithometry scoring system give a more accurate prediction on the stone-free rate compared to other scoring systems.[4]

Study on S.T.O.N.E nephrolithometry score and the PNL success rate have not been done before, thus the current study.

OBJECTIVE

To investigate free-stone rate after PNL using S.T.O.N.E nephrolitometry scoring system, with regards of stone size (S), skin-to-stone distance (T), obstruction degree (O), number of calyx involved (N), and stone density (E) in NCCT.

MATERIAL & METHODS

This study enrolled 30 patients in Soetomo General Hospital who were diagnosed with renal stone and underwent PNL during the study period between August to December 2015 and confirmed with NCCT, and met inclusion criteria of the study, which is being a primary case and aged more than 21 years-old.

Preoperative NCCT provided the data about stone size, stone-to-skin distance, obstruction degree, number of calyx involved, and stone density. Each variable then scored as shown in table 1.

Evaluation of surgical success was conducted using NCCT after 2 weeks, and deemed successful if no stone was found, or clinically insignificant stone fragment ≤ 4mm, non obstructive, non infectious, and asymptomatic on evaluation.

RESULTS

Thirty patients were treated in August until December 2015 and met inclusion criteria of this study, with mean age 53.17 ± 7.93 years, and sample description was classified based on stone-to-skin distance, age, gender, BMI, stone size, obstruction degree, number of calyx involved, and surgical outcome.

Table 2 described that out of 30 patients enrolled in this study, female gender accounts for 56.7% of patients, with the most common symptom was flank pain (93.3%), and normal BMI. Positive urine culture was found in 66.7% of patients, and post-operative NCCT showed stone-free in 63.3%, while the other 36.7% were not. Additional therapy performed on these patients include ESWL (20%), and nephroscopy (16.7%), while the other 63.3% received a conservative therapy.

S.T.O.N.E nephrolithometry score from all patients and the percentage is shown in figure 1.

Based on S.T.O.N.E nephrolithometry in table 3, mean stone size was 530.3 ± 704.3, skin-to-stone distance was 87.1 ± 29.3, and most cases presented mild obstruction with 1.05 ± 0.5 calices involved. Mean stone density was 734.6 ± 277.3, and total S.T.O.N.E nephrolithometry score was 6.3 ± 1.2. Statistical analysis found a significant correlation between stone size (p=0.005), number of calices involved (p=0.002), and overall S.T.O.N.E nephrolithometry score.

Multivariate analysis from the five sub-variables of S.T.O.N.E nephrolithometry shows that number of calices involved affects surgical outcome the most with p=0.004 and OR 4.99.

Table 1. S.T.O.N.E nephrolithometry score.

Variable	Score			
	1	2	3	4
Stone size (mm^2)	0-399	400-799	800-1599	≥1600
Tract length (mm)	≤100	>100		
Obstruction	None	Severe		
Calices (n)	1-2	3	Staghorn stone	
Essence (HU)	≤950	>950		

Table 2. Descriptive distribution of sample.

Variable	N	%	Min	Max	Mean ± SD
Age			32	67	53.17 ± 7.9
Gender					
Male	13	43.3			
Female	17	56.7			
BMI (kg/m^3)			19.8	29.1	24.16 ± 2.77
Underweight	0				
Normal weight	17	56.7			
Overweight	13	43.3			
Obese	0				
Kidney side					
Right	16	53.3			
Left	14	46.7			
Stone size (S) (mm^2)			66.8	3285.7	781 ± 881 .86
Stone-to-skin distance (T) (mm)			67.5	143.2	84.71 ± 30.07
<100	23	76.7			
>100	7	23.3			
Obstruction degree (O)					
None	20	66.7			
Severe	10	33.3			
Number of calyx (N)					
0-2	22	73.3			
3	0				
Staghorn	8	26.7			
Density (E) (HU)					
≤950	19	63.3			
>950	11	36.7			
Surgical outcome					
Stone-free	19	63.3			
Residual stone	11	36.7			
Additional therapy					
ESWL	6	20			
Nephroscopy	5	16.7			
Conservative	19	63.3			

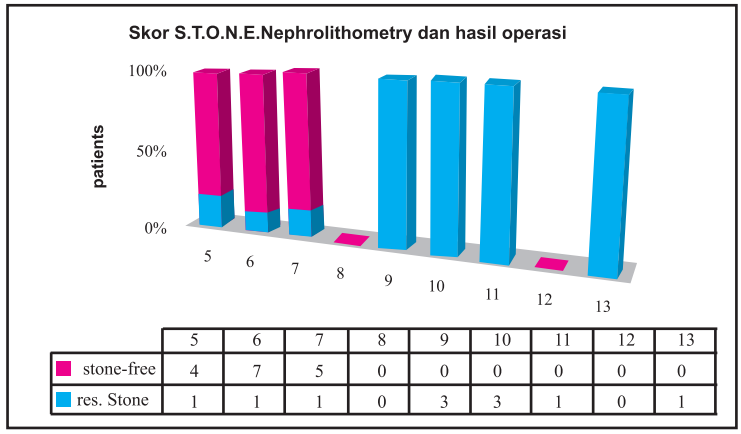

Figure 1. S.T.O.N.E nephrolithometry score and percentage.

Table 3. S.T.O.N.E nephrolithometry.

Variable	Non-stone Free	Stone Free	p
Stone size	1215 ± 1017.8	530.3 ± 704.3	0.005
Tract length	80.6 ± 32.4	87.1 ± 29.3	0.485
Obstruction			
None	1	4	0.548
Mild	6	9	
Moderate	4	3	
Severe	1	2	
Calices	2.3 ± 1.0	1.05 ± 0.5	0.002
Essence	867.7 ± 414.2	734.6 ± 277.3	0.125
S.T.O.N.E score	8.9 ± 2.3	6.3 ± 1.2	0.001

DISCUSSION

NCCT is used to evaluate characteristic complexity of stone, and have been used widely in USA. This radiology modality gives higher resolution with a more superior accuracy and details compared to other modalities.[5]

Oknunov et al developed a scoring system to predict the outcome of surgery based on an International-based study conducted in 1976 – 2012 which identified variables that will affect the outcome of PNL. This scoring system has been validated in educational multicenter and showed its relevance to the outcome of surgery. Other advantages include ease of use and software-free.[6,7]

Stone size was a significant factor regarding the outcome of PNL with p=0.005. This result is in concordance with the study conducted by Okhunov et al which stated that stone size affect the stone-free rate of PNL.[6] A study by Smith et al which enrolled 5803 patients from 96 centers that collaborated in CROES (Clinical Research Office of the Endourological Society) also stated that stone size affects the surgical outcome with p<0.001.[8]

Skin-to-stone distance have been tested and resulted with p=0.485 which shows that this variable does not significantly affect the outcome of PNL. Even though skin-to-stone distance correlates with BMI and gives more challenge in surgical technique and affects the outcome, some study stated that BMI alone does not affect the outcome of PNL.[9-11]

Zhu et al mentioned in their study that the more severe obstruction degree will affect success rate of PNL,[12] however our study shows no correlation between degree of obstruction and surgical outcome of PNL with p=0.548. This variable is insignificant because even though stone fragment can migrate to a narrow space in the pelvicaliceal system, technically a kidney with hydronephrosis is easier to puncture.[7]

Number of calices involved is significantly affecting the outcome of surgery in this study with p=0.002, which is concordance to the study conducted by Okhunov and Farhan.[6,7]

Stone density is measured in HU (Hounsfield Unit) in NCCT, and can be used to determine the density and type of stone. However, this variable does not significantly affect the outcome of PNL in this study, which is supported by several previous studies.[6,7]

Although not every component in the scoring system significantly affects the outcome of PNL individually, statistically the S.T.O.N.E nephrolithometry overall score does have a significant correlation with surgical outcome of PNL (p 0.001). This result is further supported by other literatures which mentioned that S.T.O.N.E nephrolithometry score have a strong correlation with the surgical outcome with accuracy value of 83%, even higher than the variables individually.[6,7] Meanwhile, studies conducted by Noureldin et al and Labadie et al also stated that the overall S.T.O.N.E nephrolithometry score significantly affect the outcome of PNL surgery, even though it does not differ much from Guy Scoring system.[4,5]

Linear regression model used in this study revealed that the number of calices involved affects surgical outcome the most with odds ratio 4.99. This, however, is different from the conclusion of a previous study that the stone size mostly affects surgical outcome.[6]

CONCLUSION

Lack of sample size and time of study are the weaknesses in this study. However, the researcher can conclude that S.T.O.N.E nephrolithometry

scoring system is the easiest and simplest method that can be applied in Soetomo General Hospital to predict the outcome of PNL.

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