ISSN: 2091-2331 (Print) 2091-234X (Online)

Journal of Nobel Medical College

Volume 12, Number 01, Issue 22, January-June 2023, 3-7

Original Article

Prediction of Stone Free Rate after Standard Percutaneous Nephrolithotomy using Stone Nephrolithometry Score in Nobel Medical College Teaching hospital – A Prospective Study

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Article Received: 16th October, 2022; Accepted: 5th March, 2023; Published: 30th June, 2023

DOI: https://doi.org/10.3126/jonmc.v12i1.56247

Abstract

Background

Amongst all the modalities of treatment for renal stones, percutaneous nephrolithotomy is preferred treatment for large volume renal stone disease. However, percutaneous nephrolithotomy is associated with the risk of postoperative complications and the problem of stone free status. So, a preoperative classification is necessary to grade the complexity of percutaneous nephrolithotomy and STONE (stone size, tract length, degree of obstruction, number of involved calices, and stone essence) nephrolithometry score is one of such kind.

Materials and Methods

This is analytical study conducted at the Department of Urology and Kidney Transplant, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal from January 2020 to July 2020. Total 115 patients were included in the study. These patients were subjected for percutaneous nephrolithotomy. Stone clearance was documented at the end of the surgery; on first postoperative day and at 4 weeks.

Results

In our study the stone – free rate was 89.6%. 32 patients experienced complications (27.8%). The STONE (stone size, tract length, degree of obstruction, number of involved calices, and stone essence) score correlated with the postoperative stone – free status (P=0.001). The patients rendered stone free had statistically significant lower scores than the patients with residual stones (6.83 ± 1.83 vs 9.83 ± 2.08, P = 0.001).

Conclusion

The STONE (stone size, tract length, degree of obstruction, number of involved calices, and stone essence) nephrolithometry score is a simple and easy tool to apply system for predicting complexity in stone clearance with percutaneous nephrolithotomy.

Keywords: *Kidney stones, Risk scores, Urinary tract stones*

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Citation
Shah RS, Thapa N, Shrestha JP, Koirala A, Mishra K, Jayshwal R, Pokharel S, Pandey H, Prediction of Stone Free Rate after Standard Percutaneous Nephrolithotomy using Stone Nephrolithometry Score in Nobel Medical College Teaching hospital – A Prospective Study, JoNMC. 12:1 (2023) 3-7.

Introduction

Urolithiasis is a common disease with prevalence ranging from 8 % to 19 % in males and from 3 % to 5 % in females in Western countries [1, 2]. Percutaneous Nephrolithotomy (PCNL) has overall stone free rates between 76 – 84 % and even higher [3]. It is treatment of choice for stones larger than 2 cm and lower polar stones larger than 1 cm [4]. Though PCNL is considered minimally invasive, it is not free of complications. Among the various complications of PCNL, the chance of leaving a residual stone is bothersome not only to the patients but also to the treating urologists.

This STONE score was developed by Okhunov Z et al [5] at Arthur Smith Institute for Urology, New Hyde Park, New York in 2013. It is based on 5 variables available from preoperative non contrast CT. The variables include the stone size, tract length, degree of obstruction, number of involved calices, and stone essence.

STONE nephrolithometry score is no doubt simple to use and reproducible, but probably needs more validation and comparison with other such classification systems to be accepted universally [6]. This study was carried out with an objective to predict stone clearance and complications using 'STONE' nephrolithometry score following PCNL at our institution.

Materials and Methods

This was a prospective observational study conducted at the Department of Urology and kidney Transplant, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal over a period from January 2020 to July 2020. Convenient sampling was done and sample size was calculated to be 115 using formula as shown; $n = z^2pq/e^2$ [Where, n = sample size, z = level of confidence interval at 95% so z = 1.96, p = estimated prevalence in a population (7.5%), e = acceptable sample error expressed as a percent, (5% = 0.05) and q=1-p, n = 105, Dropout = 10% (10), total sample size: 115].Patients with abnormal anatomy of upper urinary tract were excluded from the study. Ethical approval was obtained from IRC department. Informed consent was taken for enrollment.

The cases were subjected to PCNL after a negative urine culture. PCNL was done with the patient in prone position by consultant Urosurgeon. A 18G puncture needle was used for puncture of the desired calyx. A 0.035 – inch guide wire with straight tip was used to secure the tract. Serial dilatation of the tract was done with Alkenrod (8Fr) and coaxial metal dilators up to 22Fr. An amplatz sheath was inserted and the dilators were taken out. A 22Fr sized nephroscope with stone grasper was used for stone retrieval. Bigger stones were fragmented with pneumatic lithotripter. Stone clearance was ascertained with fluoroscope at the end of the procedure. Double J stent was put in all cases. The patients obtained X – ray KUB on the first postoperative day. Subsequent follow-up was done with X – ray KUB / USG in four weeks. Clearance was confirmed if there were no residual fragments or there were clinically insignificant residual stones at four weeks. Asymptomatic, non-infectious and non-obstructive stone fragments (≤4mm) remaining in the urinary system after the last session of PCNL are considered insignificant clinically. The patients were divided into those free of stones and those not free of stones. Data analysis was done with IBM SPSS statistics Base 22.0. Chi-square test, Mann-Whitney test, Fishers exact test were used.

Results

A total of 115 patients, treated by PCNL, were included in our study. The mean age of the study population was 37.68 ± 12.56 years while the mean BMI was 23.65 ± 3.66 kg/m^2. Male comprised 57% of the study population. (M: F=1.3: 1)

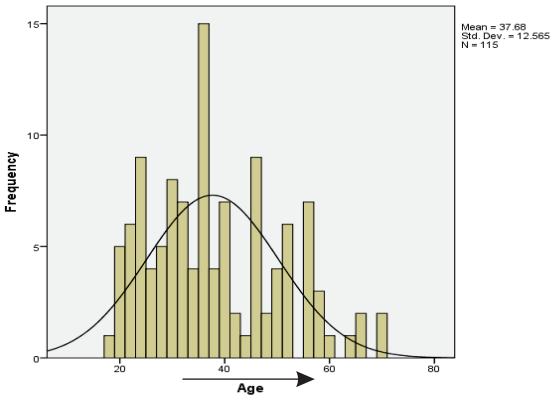

Figure 1: Age distribution of the patients

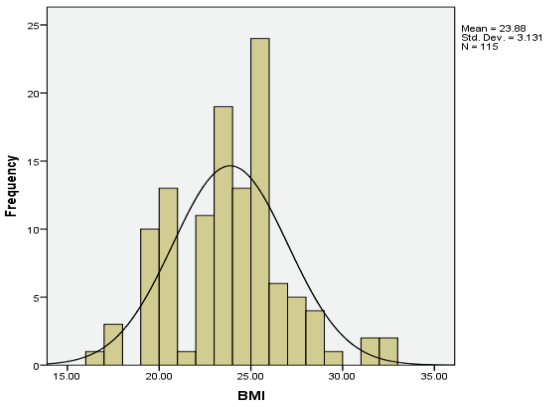

Figure 2: BMI of the patients

Table 1: Base line data of patients stratified according to STONE score

Variable, total(%)	Stone clearance status, mean ± SD or total(%) Stone free	Residual stone	P - value
Outcome	103(89.6)	12(10.4)	-
Age (in years)	38.24 ± 12.95	32.83 ± 7.22	0.213 b
Gender			
Male, 65 (56.5)	58 (89.2)	7 (10.8)	0.894 a
Female, 50 (43.5)	45 (90.0)	5 (10.0)	
BMI (kg/m^2)	23.67 ± 3.72	23.42 ± 3.16	0.608 b
Operated side			
Left, 58 (50.4)	52 (89.7)	6 (10.3)	0.975 a
Right, 57 (49.6)	51 (89.5)	6 (10.5)	
STONE Score	6.83 ± 1.83	9.83 ± 2.08	0.001 d
Size (mm^2)			
0-399, 41 (35.7)	38 (92.7)	3 (7.3)	0.001 d
400-799, 42 (36.5)	42 (100.0)	0 (0.0)	
800-1599, 19 (16.5)	16 (84.2)	3 (15.8)	
≥ 1600, 13 (11.3)	7 (53.8)	6 (46.2)	
Tract length			
≤ 100, 99 (86.1)	89 (89.9)	10 (10.1)	0.673 c
> 100, 16 (13.9)	14 (87.5)	2 (12.5)	
Obstruction			
None, 80 (69.6)	76 (95.0)	4 (5.0)	0.007 c
Severe, 35 (30.4)	27 (77.1)	8 (22.9)	
No. of calyces involved			
1-2, 92 (80.0)	89 (96.7)	3 (3.3)	0.001 d
3, 12 (10.4)	7 (58.3)	5 (41.7)	
Staghorn, 11 (9.6)	7 (63.6)	4 (36.4)	
Essence			
≤ 950, 75 (65.2)	74 (98.7)	1 (1.3)	0.001 c
> 950, 40 (34.8)	29 (72.5)	11 (27.5)	
Length of stay (days)	4.19 ± 2.48	6.17 ± 6.12	0.078 b
Operation duration (minutes)	77.57 ± 18.49	106.25 ± 14.79	0.001 b

a represents the p - value obtained using Chi – square test.
b represents the p – value obtained using Mann-Whitney test.
c represents the p – value obtained using Fishers exact test.
d represents the p – value obtained using Likelihood ratio.

Overall, 103 (89.6) patients were rendered stone free and the remaining were observed to have residual stone. The age, sex of the patients and their BMI levels had no significant associations with stone clearance as revealed by the p-value of 0.213, 0.894 and 0.608 respectively. The mean stone score was significantly higher (p-value = 0.001) in patients with residual stones. Majority of the patients had stone size ranging between 0 – 799 mm^2 and it was found that stone clearance was significantly associated (p-value = 0.001) with the size of stone.

Fisher exact test showed no significant association between stone clearance and tract length of the patients as the p-value was found to be 0.673.

Chi-square test showed significant association between obstruction and stone clearance as well as between number of calyces involved and stone clearance with p-value 0.007 and 0.001 respectively. There was a statistically significant association between stone clearance and stone essence (density) as shown by the Fisher exact test with the p-value of 0.001.

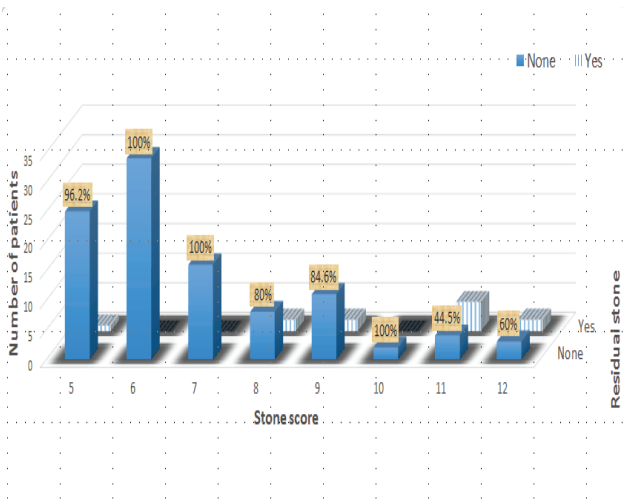

Figure 3: Plot of relationship between STONE Score and stone clearance status.

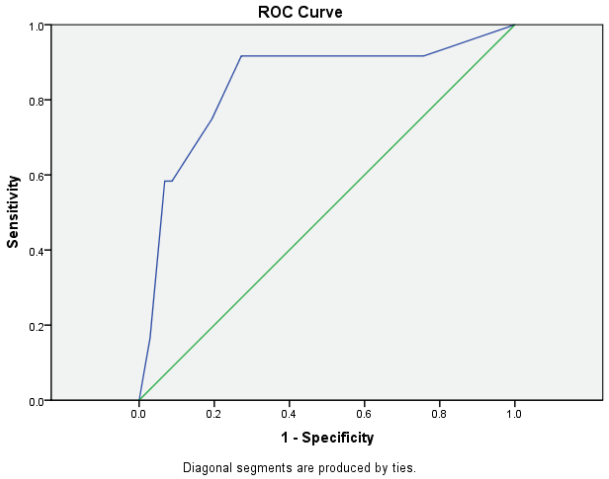

Figure 4: ROC curve of the STONE Score for predicting Free Vs Residual stone

Sensitivity, specificity, positive predictive values, and negative predictive value of the STONE Score for predicting Free Vs Residual stone are 91.7%, 72.8%, 28.2%, 98.7% respectively.

Discussion

PCNL is the commonest surgery done for the management of renal stones. It varies in complexity depending on the stone factors, anatomic factors and the patient factors [7]. Various methods of grading the complexity of renal stones have been devised by several groups and one of

such methods is the STONE nephrolithometry score was developed by Okhunov Z et al, [5] Arthur Smith Institute for Urology, New Hyde Park, New York in 2013. STONE nephrolithometry score is simple, easy to use and uses preoperative Non contrast CT scan to grade the complexity of PCNL and estimate the stone free status after PCNL. Grading the complexity would allow teaching, learning process, audit oneself and rationalize the care [8]. This study was done in patients undergoing PCNL using the STONE score to assess for the stone free status which would matter the most to the physician and the patient. Our study was conducted in 115 patients similar to that of Okhunov Z et al, [5]. Farhan et al has conducted a similar study taking 107 patients [8]. A similar study on STONE score was done by LabadieK et al, [9] taking 246 patients.

Our study showed male preponderance (56.5%) like that reported by Farhan et al (62%) [8]. The mean age of the patient at PCNL was 37.68 ± 12.56 years which is younger than that reported by Okhunov Z et al, (49.6 ± 13 years) and Farhan et al, (45.2 years) [5,8].

This shows that our population present with stone disease earlier in life probably reflecting genetic variability, nutritional deficiency and dehydration. The mean BMI of our patient was 23.65 ± 3.66 kg/m^2 which is lower than that reported by Farhan et al (27.5 Kg/m^2) and Okhunov Z et al (31.6 ± 9.5 kg/m^2). This is probably related to the dietary difference and difference in height between their population and ours.

In our study Stone size and number of calices involved were associated with residual stones but tract length was not associated which is similar to that reported by Okhunov Z et al, and Farhan et al. However, our study also showed association of residual stones with Obstruction and Essence. This is probably related to use of pneumatic lithotripter as only energy source for stone fragmentation in our institute. Joseph Petal, [10] reported clearance is extremely poor when HU > 1200 HU. Winfield et al, also reported the presence of hydronephrosis lessens the clearance rates and increases the auxiliary procedures [11].

The stone free rates according to STONE nephrolithometry score was 89.6% which is better than that reported by Okhunov Z et al, Noureldin YA et al, Farhan et al. The stone free rates reported Okhunov Z et al was 80%. On the contrary, the stone free rates reported by Noureldin YA et al was 71.9%. A recent study by Farhan et al report stone free rates of 80%.

Conclusion

STONE score is a simple tool to predict stone free rates in patients undergoing PCNL. Higher the STONE score, less is the chance of stone free rates.

Recommendation

The current study showed higher STONE score, based on preoperative variables, was associated with residual stone status. Thus, this scoring system can be used to predict and counsel patient undergoing PCNL about residual stones preoperatively.

Acknowledgement

Special thanks to Department of Radiodiagnosis, Nobel Medical College for valuable assistance in the study.

Conflict of interest

There are no conflicts of interest.

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