STONE NEPHROLITHOMETRY FOR EVALUATING STONE CLEARANCE AFTER PERCUTANEOUS NEPHROLITHOTOMY

Qamar Zia, Faran Kiyani, Muhammad Nawaz, Mujahid Ali Khoso, Muhammed Asghar, Syed Mukkaram Ali*

Armed Forces Institute of Urology/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To calculate stone nephrolithometry score in patients undergoing percutaneous nephrolithotomy (PCNL) and its correlation with stone clearance.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Urology (AFIU) Rawalpindi, from Jan 2015 till Jul 2015

Material and Methods: A total of 90 patients were included in the study after calculating the sample size using WHO sample calculator. After ethical review committee approval, all patients who fulfilled the inclusion criteria were included in the study by non-probability purposive sampling technique. Five variables available from preoperative non-contrast computed tomography (CT) were measured by a single radiologist then each variable was scored according to predefined score proposed by Okhunov Z and finally stone Nephrolithometry score was calculated by the sum of individual variable scores. Post-operatively stone clearance was assessed by plain x-ray kidney ureter and bladder, done within 1 week after the procedure. The frequency of stone clearance after PCNL at different stone Nephrolithometry scores was determined.

Results: The patient's mean age was 52.11 ± 16.33 years among which 74.44% patients were males and 25.56% patients were females. The stone nephrolithometry mean score of the patients was 9.36 ± 1.86 and stone clearance was seen in 90% patients. Statistically significant difference was found between the score and stone clearance.

Conclusion: Stone nephrolithometry score is associated with post-PCNL stone clearance rates.

Keywords: Computer tomography, Nomograms, Percutaneous nephrolithotomy, Renal stones.

INTRODUCTION

Nephrolithiasis has prevalence of approximately 2 to 3 percent in the general population and is among one of the most common urological ailment[1]. Known since ancient times. There is 12 percent estimated lifetime risk of developing a kidney stone[1]. Pakistan is located in stone belt region with very high incidence of renal stones[2]. With development of minimally invasive endoscopic techniques and extra corporeal lithotripsy, the classically performed open surgery for removal of renal stone is almost obsolete. At present percutaneous nephrolithotomy (PCNL) is accepted as procedure of choice for renal stone[3]. Although guideline are available regarding indication of PCNL[4], but still the

Correspondence: Dr Muhammad Nawaz, Urologist, Armed Forces Institute of Urology Rawalpindi Pakistan

Email:memoriesnawaz@yahoo.com

urologic community remains without a standardized system to predict the outcome of PCNL. The instruments currently available to predict the PCNL outcomes are not only cumbersome but also they have not been validated. Moreover they are of limited clinical utility[5-6]. Okhunov *et al* in 2013[7] proposed a novel quantitative scoring system, the S.T.O.N.E. nephrolithometry score. The scoring system is based on 5 variables obtained from preoperative non contrast enhanced computerized tomogram (CT). They in their study proposed that reproducible, standar-dized parameters obtained from computed tomography imaging using this nephrolithometry score can be used for preoperative patient counseling, surgical planning, and evaluation of surgical outcomes across institution and within medical studies. Moreover the STONE nephrolithometry has excellent inter-observer reliability. In a study having 117

patients who underwent PCNL the mean score was 7.7% (4-11). Stone clearance was 94% in score range of 3-5 whereas it decreased to 69% in scores of 9-12[8]. In Pakistan PCNL is a very common procedure, but unfortunately we do not have any standardized method or preoperative tool which can predict stone clearance after PCNL. In our study we aim to calculate STONE nephrolithometry score in patients undergoing PCNL and its associaton with stone clearance. Our study can help in clinical practice to counsel our patients preoperatively regarding their stone clearance and need of any ancillary procedure.

Stone nephrolithometry score system was proposed by *Okhunov et al*[7] and is based on 5 variables obtained from non-contrast enhanced computed tomography which include stone size (millimeter-squared, mm^2), tract length (skin-to-stone distance in mm), degree of obstruction (presence of hydronephrosis), number of involved calices, and stone essence (stone density in Hounsfield unit, HU). All the mentioned variables were measured from preoperative non-contrast enhanced CT scan by a single radiologist. Then each variable was scored according to predefined score and finally stone nephro-lithometry score was calculated by the sum of individual variable score for stone clearance.

MATERIAL AND METHODS

The study was carried out at AFIU from 1st January 2015 till 6th July 2015. It was a descriptive cross-sectional study. Sample size of 90 was calculated by using World Health Organization (WHO) sample size calculator taking proportion of stone clearance on score 3-13 with mean 7.7 ± 1.758, confidence interval 95% and margin of error d=0.875%. Sampling was performed by non-probability, purposive sampling technique. All patients between the ages 16-80 years of both genders with renal stone diagnosed and confirmed by non contrast enhanced CT scan, done in AFIU and planned for PCNL were included. Patient's with active urinary tract infection, coagulopathy, skeletal deformity, pregnancy, patients who previously

had any surgery or extracorporeal shockwave lithotripsy for stone and had residual fragments and patient's in which procedure was not complete due to intra operative complications were excluded from the study. After ethical review committee approval, all patients who fulfilled the inclusion criteria, were included in the study. Five variables available from pre-operative non-contrast CT was measured by a single radiologist (having more than 05 year experience), then each variable was scored according to predefined score proposed by Okhunov *et al*. and finally stone nephroli-thometry score was calculated by the sum of individual variable scores. Stone clearance is defined as no stone visible or residual fragments less than 4mm on plain x-ray kidney, ureter and bladder within one week after procedure. Post-operatively stone clearance was assessed by plain x-ray kidney ureter and bladder, done within one week after the procedure. We determined the frequency of stone clearance after PCNL at different stone nephrolithometry scores. The data were recorded and analyzed in SPSS version 19. Mean and standard deviation were calculated for quantitative variables i.e. age, score and stone size. Frequency and percentages were calculated for qualitative variables, i.e. stone clearance (yes/no) on different scores. Fisher's exact test and independent sample t-test was applied to find association between variables where appropriate. A *p*-value of <0.05 was considered as statistically significant.

RESULTS

A total of 90 cases were included with the mean age of 52.11 ± 16.33 years with minimum and maximum ages of 22 and 80 years respectively. There were 67 (74.44%) males and 23 (25.56%) female patients. The male to female ratio of the patients was 2.9:1. Underweight body mass index (BMI) patients were 16 (17.8%), normal BMI patients were 24 (26.7%), overweight BMI patients were 38 (42.2%) and obese patients were 12 (13.3%). The study results showed that the mean stone size of the cases was 18.61 ± $2.15mm^2$ with minimum and maximum sizes of

15 and 22 mm^2 respectively. Whereas the mean score value of the patients was 9.36 ± 1.86 with minimum and maximum scores of 6 and 12 respectively. Out of 90 cases, stone clearance was seen in 81 (90%) patients. In this study the mean age of the stone cleared patients was 51.43 ± 16.28 years and the mean age in without stone cleared patients was 58.22 ± 16.46 years. Statistically insignificant difference was found between the age in years and stone clearance of the patients (*p*-value=0.239). Out of 67 male cases, stone was cleared in 62 cases. Similarly out of 23 female cases, stone was cleared in 19 cases. Statistically insignificant difference was observed between both genders (*p*-value=0.23). The study results showed that among 16 underweight cases,

evolution, increasing the success rates of the procedure. We performed a literature search using entrez pub med from Jan 2000 to Jul 2007 concerning PNL and many aspects related to all steps of the procedure[9]. In our study stone clearance was seen in 90% patients and it was not cleared in 10% patients undergoing PCNL. Ali *et al*[10] showed that the PCNL has a good success rate which supports our study result. There was minimal blood loss, and few major complications. Stone clearance rate by PCNL as mono-therapy was 80.57%. In 15.43% (n=27) patients, Extra-corporeal shock wave lithotripsy (ESWL) was needed and total stone free rate was 95.98%. A success rate of 98.3% had been reported from Mayo Clinic in a series of 1000 patients for the

Table-I: Stone nephrolithometry.

S No.	Variables	1	2	3	4
1	Stone size (mm^2)	0-399	400-799	800-1599	1600
2	Tract length (mm)	≤100	>100		
3	Obstruction	None	Present		
4	No of involved calices (n)	1-2	3	Staghorn	
5	Stone essence (HU)	<950	>950		

Table-II: Comparison of stone size and STONE score in stone clearance groups

Variable	Stone clearance		*p*-value
	Yes (n=81)	No (n=9)	
Stone size (mean ± SD)	18.54 ± 2.15	19.22 ± 2.11	0.37
Stone score (mean ± SD)	9.21 ± 1.84	10.67 ± 1.50	0.02

stone was cleared in 15 cases, in 24 normal weight cases, stone was cleared in 22 cases, in 38 overweight cases, stone was cleared in 32 cases and in 12 obese cases, stone was cleared in all the 12 cases. This was also statistically insignificant (*p*-value=0.381). Details are in table-I.

Statistically insignificant difference was observed between stone size and stone clearance (p-value=0.37), whereas statistically significant difference was found between the score and stone clearance (*p*-value=0.02). Details are in table-II.

DISCUSSION

PCNL is the procedure of choice for large renal stones. Since its introduction in 1976, many aspects of the operative technique and the endoscopic equipments have had constant

small symptomatic calculi of upper ureter and renal pelvis[11].

A more recent study by Denstedt and colleagues[12] showed that primary PCNL resulted in better stone free rates than sandwich therapy (84% versus 63%) with shorter hospital stay (6 days versus 12.2 days) and decreased need for blood transfusion (1.6% versus 14%). Karami *et al*[13] reported performing PCNL under ultrasound (USG) guidance in 40 patients in the lateral position with an access rate of 100% and a complete stone-removal rate of 85%. Song Yan *et al*[14] concluded in their study that the PCNL can be performed safely and effectively using solely USG guidance for various types of stones, resulting in a high stone-free rate and a low complication rate.

A study by Labadie *et al*[15] showed that stone-free patients versus those with residual stones the mean Guy score was 2.2 vs 2.7, the mean stone score was 8.3 vs 9.5 and the mean clinical research office of the endourological society (CROES) nomogram score was 222 vs 187 (each *p*<0.001). Logistic regression revealed that the Guy, stone nephrolithometry and CROES nomogram scores were significantly associated with stone-free status (*p*=0.02, 0.004 and <0.001, respectively).

Okhunov *et al*[7] demonstrated in their study that stone 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 (6.8 vs 9.7, *p*=0.002). Additionally, the score correlated with the estimated blood loss (*p*=0.005), operative time (*p*=0.001), and length of hospital stay (*p*=0.001). Another study described that the inter observer reliability for the total score demonstrated high correlations for all components and total score (ICC=stone and total 0.80, 0.97, 0.89, 0.84, 0.91, and 0.87, respectively). A *p*-value for all the scoring components was <0.05, indicating that the estimated frequencies was not a result of chance[8].

CONCLUSION

The results of our study concluded that STONE nephrolithometry score is an easy to use nomogram that is associated with post-PCNL stone clearance rates.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

REFERENCES

1. Gupta R, Gupta A, Singh G, Suri A, Mohan SK, Gupta CL. PCNL-A comparative study in nonoperated and in previously operated (open nephrolithotomy/pyelolithotomy) patients-A single-surgeon experience. Int Braz J Urol 2011; 37(6): 739–44.
2. Bultitude M, Rees J. Management of renal colic. BMJ 2012; 345: e5499.
3. Lim SH, Jeong BC, Seo S Il, Jeon SS. Treatment Outcomes of Retrograde Intrarenal Surgery for Renal Stones and Predictive Factors of Stone-Free. Korean J Urol 2010; 51(11): 777-782.
4. Agarwal M, Agrawal MS, Jaiswal A, Kumar D, Yadav H, Lavania P. Safety and efficacy of ultrasonography as an adjunct to fluoroscopy for renal access in percutaneous nephrolithotomy (PCNL). BJU Int 2011; 108(8): 1346–9.
5. Thomas K, Smith NC, Hegarty N, Glass JM. The Guy's Stone Score-Grading the Complexity of Percutaneous Nephrolithotomy Procedures. Urology 2011; 78(2): 277–81.
6. Mishra S, Sabnis RB, Desai M. Second Prize: Staghorn Morphometry: A New Tool for Clinical Classification and Prediction Model for Percutaneous Nephrolithotomy Monotherapy. J Endourol 2012; 26(1): 6–14.
7. Okhunov Z, Friedlander JI, George AK, Duty BD, Moreira DM. S.T.O.N.E. Nephrolithometry: Novel Sur-gical Classification System for Kidney Calculi. Urology 2013; 81(6): 1154–60.
8. Okhunov Z, Helmy M, Perez-Lansac A, Menhadji A, Bucur P, Kolla SB, et al. Interobserver reliability and reproducibility of s.t.o.n.e. Nephrolithometry for renal calculi. J Endourol 2013; 27(10): 1303–6.
9. Vicentini FC, Gomes CM, Danilovic A, Neto EAC, Mazzucchi E, Srougi M. Percutaneous nephrolithotomy: Current concepts. Indian J Urol 2009; 25(1): 4–10.
10. Ali S, Kumar N, Baloch U. Outcome of Percutaneous Nephrolithotomy 2014; 24(4): 261–4.
11. Kim SC, Kuo RL, Lingeman JE. Percutaneous nephrolithotomy: an update. Curr Opin Urol. 2003; 13(3): 235–41.
12. Denstedt Jd, Razvi HA, Sales JL, Eberwein PM. Preliminary Experience with Holmium:YAG Laser Lithotripsy. J Endourol 1995; 9(3): 255–8.
13. Karami H, Rezaei A, Mohammadhosseini M, Javanmard B, Mazloomfard M, Lotfi B. Ultrasonography-Guided Percutaneous Nephrolithotomy in the Flank Position Versus Fluoroscopy-Guided Percutaneous Nephrolithotomy in the Prone Position: A Comparative Study. J Endourol 2010; 24(8): 1357–61.
14. Yan S, Xiang F, Yongsheng S. Percutaneous nephrolithotomy guided solely by ultrasonography: A 5-year study of >700 cases. BJU Int 2013; 112(7): 1-5.
15. Labadie K, Okhunov Z, Akhavein A, Moreira DM, Moreno-Palacios J, del Junco M, et al. Evaluation and Comparison of Urolithiasis Scoring Systems Used in Percutaneous Kidney Stone Surgery. J Urol 2015; 193(1): 154–9.

....