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Guy's stone score: A predictive tool for outcomes of percutaneous nephrolithotomy.

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Abstract

Background: Predicting stone clearance before intervention can be useful to plan the modality of treatment and calculate the cost of procedures. Therefore, this study aims to determine the frequency of successful stone clearance in a patient undergoing percutaneous nephrolithotomy (PCNL) with different categories of Guy's Stone Score (GSS).

Methodology: A total of 115 patients undergoing standard PCNL from January to December 2018 were included in this study. According to GSS I-IV, patients were then categorized into four groups after having pre-operative Computed Tomography of Kidney, Ureter, and Bladder (KUB). All the patients received standard general anesthesia and underwent standard PCNL in a prone position. The Percutaneous nephrostomy 18-gauge needle is passed into the pelvis of the kidney, Pelvi-calyceal system opacified and confirmed using fluoroscopy, a guidewire is passed, and 30 Fr Amplatz sheath is introduced after serial dilatation. A 26 Fr nephroscope is then inserted through the working sheath, and the stone is fragmented and removed. Finally, a nephrostomy drain tube is kept at the puncture site. The outcome was accessed in terms of stone clearance rate after PCNL on the 2nd postoperative day using the radiological modality of CT-KUB.

Results: Among the 115 patients here were 48(41.7%) categorized as GSS I, 26(22.6%) categorized as GSSII, 20(17.4%) categorized as GSS III, and 21(18.3%) categorized as GSS IV. The overall stone clearance observed was 64.3%, individual stone clearance was GSS I=91.66%, GSS II=53.84%, GSS III=50%, and GSS IV=28.57%. Stone clearance among the different GSS categories was significantly different (p<0.01).

Conclusion: The Guy's Stone Score, based on CT scan findings, is a significant system in predicting successful stone-free rates. It is a convenient, quick, and efficient tool for pre-operative assessment, and it can be incorporated as a mandatory protocol before planning PCNL.

Keywords

Percutaneous Nephrolithotomy, Guy's Stone Score, Computed Tomography of Kidney, Ureter & Bladder.

Introduction

Kidney stones disease affects the population across the globe. The usual risk of having Urolithiasis in a person's lifetime is about 10 to 15% among the developed nations and estimated as high as 20 to 25% in the Middle Eastern zone, probably due to the risk of dehydration during hot weather. Moreover, the diet consumed contains half the levels of calcium and 2.5 times higher oxalates contents compared to Western population diets. This is the main reason for the high risk of stones in the Middle East and South Asian population[1]. Reported death rates after stone treatment are around 2550 over the last two decades in a meta-analysis[2].

Renal stone management is based on various factors, including site, size, stone hardness, and renal anatomy. American urological association (AUA) proposes guidelines for treating renal stones using different but feasible techniques, including extracorporeal shockwave lithotripsy (ESWL)[3], flexible ureterorenoscopy (URS)[4] using lasers for fragmentation of renal stones, open[5] and laparoscopic pyelolithotomy[6], and PCNL[7-8]. Although laparoscopic Pyelolithotomy has shown promising results6 among all these procedures, PCNL is the least invasive procedure and is considered a gold standard treatment option for large renal calculi because of its high stone clearance and low complications[9-10]. AUA also recommends using more than one modality in certain cases where it is mandatory or sometimes as an ancillary procedure to improve outcomes and reduce morbidity[10-11].

Furthermore, there are guidelines available for the indications of PCNL and assess and grade complications[12-17]. Distinguished researchers have done vast research to publish different tools and methods to classify the renal stone burden and provide a tool for standardization that could help predict outcomes pre-operatively like stone-free rate (SFR) and complications. Common contemporary predictive tools used for percutaneous nephrolithotomy outcomes are the CROES, Guy stone score[18-20], and the stone nephrolithometry nomogram[21-23]. According to Labadie et al. and others, all these three tools were equally predictive of SFR in patients undergoing the procedure[24,25]. According to Clavien-Dindo classification, these tools were not able to predict the complications[25,26].

The GSS was first published by Thomas et al. and proved convenient and applicable[20], even in the pediatric population[27]. Originally Guy stone scoring was done variably using Xray/IVP or CT-KUB. We standardized and used only the best modality of pre-operative CT-KUB to estimate stone status[20, 28]. It is classified into four Grades; Grade I classify as a single stone in the inter-polar, lower pole, or in pelvis region with simple anatomy, Grade II is classified as a single stone at the upper pole with simple anatomy or more than one stone in a patient with simple anatomy or single stone in a patient having abnormal renal anatomy, Grade III is classified as Multiple stones in a patient having abnormal anatomy or stones in a calyceal diverticulum or Partial staghorn stone, Grade IV is classified as the patient having a Staghorn stone or any stone in a patient suffering from Spina Bifida or Spinal Injury (Figure 1)[20,29].

Post-operatively radiological investigations like X-ray KUB or Ultrasound kidney, Ureter, and Bladder (U/S KUB for Radiolucent stones) or CT-KUB were used to see stone-free rate[20,28]. Vicentini et al. concluded overall stone clearance rate around 71.6% after stratifying with Guy's Stone Score, which differed significantly among different grades (GSS I= 95.2%, GSS II= 79.5%, GSS III= 59.5%, and GSS IV= 40.7%)[28].

This study aims to predict stone-free status using Guy's Stone Grading system, as it's a valid tool to clear obscurity, has significant advantages for counselling patients pre-operatively, auditing purpose, the teaching of trainee's, and anticipating future auxiliary procedures. This provides a strong rationale for conducting this study.

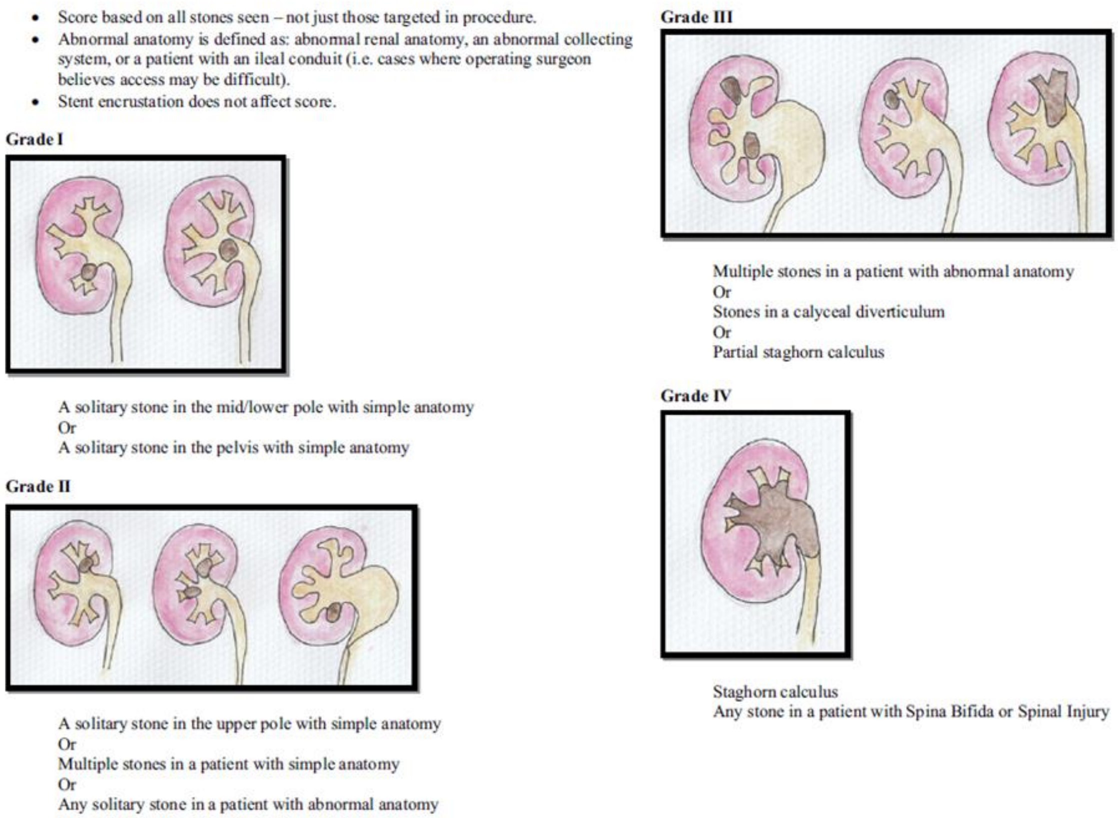

Figure 1: Guy's Stone Score (Reprinted and adapted with permission[29]).

Methodology

This prospective cross-sectional study was conducted at the urology department of the Kidney Centre, Postgraduate Training Institute Karachi, Pakistan, from January 2018 to December 2018. It was approved by the Institutional Research Committee of the Kidney Center, Karachi, Pakistan. A total of 115 consecutive patients undergoing standard PCNL in the prone position were enrolled after obtaining written informed consent and counselled about the outcome, possible complications, and advantages of the PCNL procedure.

Inclusion Criteria set for patients undergoing standard PCNL having renal stone of any duration diagnosis confirmed by CT scan-KUB. Patients with either gender aged between 20-60 years and size criteria were patients with renal stones of more than 2 cm or 1.5 cm for lower pole stones and multiple stones cumulatively > 2.0 cm. All patients were categorized among any 4 grades of Guy's Stone Score according to CT-KUB findings. On the contrary, patients with concomitant ureteral calculi, a history of deranged coagulopathy confirmed by clotting profile, and untreated Urinary tract infections confirmed by Urine culture reports were all excluded. CT-KUB without contrast and standard serum examinations were done on the second postoperative day in each patient. The outcome was labelled successful when residual stones were absent or the presence of asymptomatic fragments less than 4 mm.

To analyze the data, Statistical analysis was done using a SPSS version 20.0. The results were expressed as the mean±SD, frequency and percentages. Each Guy's stone score category was analyzed using the Chi-square test for categorical variables and one-way analysis of variance for numerical variables. A significant p-value was set at < 0.05.

Results

A total of 115 patients who underwent standard PCNL and fulfilled the inclusion criteria were included in this study. Patients are categorized among IV grades of Guy's Stone Score. There were 72(62.6%) males, and 43(37.4%) females enrolled. The average age of the patients was 40.77 ± 11.33 years as shown in table 1. There were 48(41.7%) categorized as GSS I, 26(22.6%) categorized as GSS II, 20(17.4%) categorized as GSS III, and 21(18.3%) categorized as GSS IV presented in table 2. Overall Stone free rate noted as 74(64.3%) cleared and 41(35.7%) had significant residual. Individual stone clearance was GSS I=91.66%, GSS II=53.84%, GSS III=50%, and GSS IV =28.57%, which is quite comparable to previous reference studies see table 2. Stone clearance among the different GSS categories was significantly different ($p<0.01$). Stratification was performed to observe the effect of age and gender on the stone-free rate. It was observed that there is no significant effect of Age and Gender on stone-free rate within respective Guy's stone score category ($p=0.122$). On the other hand, BMI does make a significant difference in the stone-free rate ($p=0.02$).

Table 1: Baseline demographics and clinical characteristics of PCNL patients.

Variables		n=115
Age (years)		40.77±11.33 (20-40)
Gender	Male	72(62.6)
	Female	43(37.4)
Weight (kg)		72.2±17.17
BMI (kg/m^2)		27.14±5.99
Guy's Stone Score	I	48(41.7)
	II	26(22.6)
	III	20(17.4)
	IV	21(18.3)

BMI-Body Mass Index; PCNL-Percutaneous Nephrolithotomy

Table 2: Comparison of stone-free rate.

Variables	Total patients (%)	Stone Free Patients (%)
GSS I	41.7	91.6
GSS II	22.6	53.8
GSS III	17.4	50.0
GSS IV	18.3	28.5

Discussion

Our study endorsed findings concluded in previous similar studies like Thomas et al[20], Vicentini et al[28] and Labadie et al[24] done to predict stone clearance using GSS. Methods of treating renal stones evaluated from an open surgical approach to minimally invasive PCNL vary considerably. It is well known that PCNL outcomes vary with stone complexity, but no straightforward system of categorizing stone complexity was available[26]. So far in the available data, it has been proven that the outcome of PCNL in complex stones, i.e. GSS IV, is worse than simple stones of GSS I. Concurrently, there was confusion in classifying GSSII and GSSIII as difficult anatomy is not equally understandable. Moreover, there was a lack of a unified definition for partial staghorn stones[30]. Despite that, the GSS is a convenient, fast, and practically possible way for grading the complexity of stones before going for PCNL. GSS correlates well with the stone-free rate (SFR). This score gives an advantage to understand complexity and outcomes and for pre-operative counselling of patients. Furthermore, medical students' academic teaching, self-learning, revalidation, and costing can also be achieved[8]. Advancement and research in PCNL would be convenient by using and comparing with a valid grading system.

In this current era, the concept of highly focused, expert surgical services and referrals to high flow Centers are well established and followed. This stone score could help categorize and plan which patient needs to be referred to an expert for better outcomes. Moreover, this organized and repeatable grading system is suitable for comparing different hospitals unit, urologists, and their techniques.

This study now verifies the GSS made on CT-KUB findings is adequate to prove the GSS potential of evaluating PCNL outcomes. Hence this score can be set as a protocol for routine scheduling PCNL and not just for research papers. Landis and Koch suggested that this score is 86% reproducible among different observers of this scoring system[20, 30-32]. GSS is a better way to accurately predict outcomes, especially stone clearance, whether it is calculated via ultrasound KUB, X-ray KUB, or CT-KUB[33]. It's a proven fact that a CT scan has the highest specificity and sensitivity compared to other imaging instruments in assessing Urolithiasis, so it should be preferred[34,35]. Unfortunately, there are limitations to the implementation of this study due to the limited availability of CT-KUB[36] and PCNL facilities in small cities and rural areas.

Conclusion

The study concludes that GSS calculated on CT-KUB can be used as a reliable tool in predicting stone-free rates after PCNL with efficiency and accuracy. It is a convenient method for pre-operative evaluation and could be used as a routine protocol before proceeding with PCNL. GSS can help scientifically and logically for patient counselling and academic learning.

Conflicts of Interest

The authors have declared that no competing interests exist.

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