RESEARCH ARTICLE

Urinary tract infections in complicated kidney stones: Can they be correlated with Guy's stone score?

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Abstract

Objective: To ascertain the existence of a connection between Guy's stone score and infectious complications after percutaneous nephrolitholapaxy.

Methods: The retrospective cohort, multi-centre study was conducted in the urology departments of Prof Dr Theodor Burghele Clinical Hospital and C.I. Parhon Clinical Hospital, Romania, and included data of patients who underwent percutaneous nephrolitholapaxy from January 1, 2017, to December 31, 2019. Based on urography, the subjects were assigned to four groups, from GSS1 to GSS4, in accordance with the Guy's stone score classification. The complication rate after percutaneous nephrolitholapaxy was classified using the modified Clavien staging classification. Demographics, preoperative urine cultures, and the rate of complications were compared. Data was analysed using SPSS 24.

Results: Of the 246 patients, 116(47.2%) were males and 130(52.8%) were females. The overall mean age was 53.06±13.04 years (range: 18-83). The mean Guy's stone score was 1.82±0.9. The rate of percutaneous nephrolitholapaxy success was 160(65.04%). There were 105(42.68%) patients in GSS1 group, 63(25.60%) in GSS2, 24(9.75%) in GSS3 and 54(21.95%) in GSS4. There were significantly more preoperative positive urine culture in GSS3 and GSS4 groups compared to GSS1 and GSS2 groups ($p<0.05$). The rates of complications were statistically different among the groups ($p=0.019$).

Conclusion: Urinary tract infections were found more frequently in patients with higher Guy's stone scores compared to those with low scores. The Guy's stone score classification were found to be a useful tool in predicting the immediate success rate of percutaneous nephrolitholapaxy.

Keywords: Kidney, Stones, Infection, PCNL. (JPMA 72: 1721; 2022) **DOI: https://doi.org/10.47391/JPMA.3172**

Introduction

Kidney stone disease (KSD) has a high prevalence worldwide, and a multifactorial pathogenesis. First described 50 years ago, percutaneous nephrolitholapaxy (PCNL) is the main procedure for approaching kidney calculi >20mm in size and staghorn calculi, replacing open surgical methods. Despite the advances in technology, the PCNL technique does not always lead to stone-free status, which is the targeted outcome. This is the main reason why many scoring systems and nomograms have been developed to predict complications of PCNL and the rate of total stone elimination.

The most commonly used scoring systems are Guy's stone score (GSS), Seoul National University Renal Stone Complexity (S-ReSC) scoring system, Stone size, Tract length, Obstruction, Number of involved calices, and Essence or stone density (STONE) nephrolithometry score, and the Clinical Research Office of the Endourological Society (CROES) nephrolithometry nomogram.[1] Of all these systems, GSS seems to be the simplest, fastest, and easiest to perform, being easily reproducible in evaluating the stone-free rate (SFR) and the rate of complications.[1]

Urinary tract infections (UTIs) have long been associated with urinary lithiasis, and its presence may increase the rate of complications of minimally invasive interventions. In case the patient has big, staghorn calculi or positive urine culture, an antibiotic is administered the day before the surgery.[2]

The current study ws planned to try to ascertain the existence of a connection between GSS classification and infectious complications post-PCNL.

Methods

The retrospective cohort, multi-centre study was conducted in the urology departments of Prof Dr Theodor Burghele Clinical Hospital and C.I. Parhon Clinical Hospital, Romania, and included data of patients who underwent percutaneous nephrolitholapaxy from January 1, 2017, to December 31, 2019.

After approval from the ethics review boards of the

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Table-1: Guy's Stone Score (GSS) classification.

Guy's stone score 1 (GSS1)	A solitary stone in the mid/and or lower pole or the renal pelvis with normal anatomy and a simple collecting system
Guy's stone score 2 (GSS2)	A solitary stone in the upper pole; multiple stones in patients with simple anatomy; or a solitary stone in a patient with abnormal anatomy
Guy's stone score 3 (GSS3)	Multiple stones in a patient with abnormal anatomy or a calyceal diverticulum or partial staghorn calculus
Guy's stone score 4 (GSS4)	A complete staghorn calculus or any stone in a patient with Spina Bifida or a spinal injury, calculus in patients with clinical neurological alternations (spinal cord injury, myelomeningocele).

participating institutions, data was retrieved related to all cases that underwent PCNL, and had urography and urine culture done preoperatively. No case was excluded.

After examining the urography, the cases were categorised into four groups, from GSS1 to GSS4, in accordance with the GSS classification (Table 1). PCNLs were done while having the patient in ventral decubitus. Ultrasonography and fluoroscopy were necessary for guiding while creating access. Amplatz dilators were used for expanding the access. The stones were fragmented by using a pneumatic lithotripter (Swiss LithoClast®). Postoperatively, all patients were evaluated using plain kidney-ureter-bladder (KUB) radiography. Patients with larger residual stones were re-treated by PCNL following the same puncture tract or via re-puncture. Patients who had smaller fragments left after PCNL were subjected to extracorporeal shock wave lithotripsy (ESWL) or were administered medical expulsion treatment.

PCNL procedure was considerd a success in stone-free patients or in cases with residual fragments but with no symptomatology and dimensions smaller or equal to 4mm on postoperative KUB radiography. Complications were classified using the modified Clavien staging.[3] All patients received antibiotic prophylaxis at least 24 hours before surgery. Data regarding demographics, previous renal surgery, or the presence of ureteral or nephrostomy stents was collected. Data was analysed using SPSS 24. Analysis of variance (ANOVA) and Chi-square tests, as appropriate. P<0.05 was considered statistically significant.

Results

Of the 246 patients, 116(47.2%) were males and 130(52.8%) were females. The overall mean age was 53.06±13.04 years (range: 18-83). The mean Guy's stone score was 1.82±0.9. The rate of percutaneous nephrolitholapaxy success was 160(65.04%). There were 105(42.68%) patients in GSS1 group, 63(25.60%) in GSS2, 24(9.75%) in GSS3 and 54(21.95%) in GSS4. Of the total, 127(51.62%) patients had a previous history of surgery for kidney calculi, and in GSS4 group, the number of such patients was significantly lower than the number of patients with no history of surgery (p<0.05). Overall, 41(16.66%) patients had JJ ureteral stents or nephrostomies indwelled previous to the PCNL and inter-group differences were not significant (p=0.95). There were significantly more preoperative positive urine culture in GSS3 and GSS4 groups compared to GSS1 and GSS2 groups (p<0.05) (Table 2). Of the 62 germs identified in preoperative positive urine cultures, 35(56.5%) were *Escherichia (E.) coli* (Table 3).

The rates of complications were statistically different among the groups (p=0.019) (Table 4).

Table-2: Demographics and outcomes.

	GSS 1	GSS 2	GSS 3	GSS 4	*p*-value
No. patients (n=246)	105 (42.68%)	63 (25.60%)	24 (9.75%)	54 (21.95%)	
Mean age (years)	52.99±13.34)	53.43±12.13)	53.38±14.82)	52.61±12.94)	0.987
Gender M/F	49/56	36/27	10/14	21/33	0.23
Previous kidney stone surgery (n)	52 (49.52%)	41 (65.07%)	15 (62.5%)	19 (35.18%)	0.0083
Previous ureteral stents or nephrostomy tubes	19 (18.09%)	10 (15.87%)	4 (16.66%)	8 (14.81%)	0.95
Re-PCNL (n)	5 (4.76%)	18 (28.57%)	4 (16.66%)	25 (46.29%)	<0.00001
Outcome (stone-free)	96 (91.42%)	37 (58.63%)	15 (62.5%)	12 (22.22%)	<0.00001
Preoperative positive urine culture (n)	23 (21.90%)	10 (15.87%)	8 (33.33%)	21 (38.88%)	0.021

GSS: Guy's Stone Score, SD: Standard deviation, M; Male, F: Female, PCNL: Percutaneous nephrolitholapaxy.

Table-3: Positive urine cultures in each group.

	GSS 1	GSS 2	GSS 3	GSS 4	Total
E.coli	14	6	5	9	34 (54.83%)
Klebsiella spp.	2	2		7	11 (17.74%)
Enterococcus	2			1	3 (4.83%)
Proteus	1	1	2	2	6 (9.67%)
Pseudomonas	2	1		1	4 (6.45%)
Staphlycoccus	1		1	1	3 (4.83%)
Candida kefir	1				1 (1.62%)
Total	23	10	8	21	

GSS: Guy's Stone Score, E: Escherichia, Spp: Species.

Table-4: Positive urine cultures in each group.

Clavien grade	GSS 1	GSS 2	GSS 3	GSS 4	Total
I	14	8	4	5	31 (12.60%)
II	5	3	2	8	18 (7.31%)
IIIa	1	1	2	6	10 (4.06%)
IIIb	1	2	1	3	7 (2.84%)
IV	0	0	0	0	0
V	0	0	0	0	0
Total	21 (20%)	14 (22.22%)	9 (37.5%)	22 (40.74%)	66 (26.82%)

GSS: Guy's Stone Score.

Discussions

KSD is one of the most common reasons for visiting urologists. In recent years, advances in surgical technology and technique made open surgical methods obsolete, replacing them with less invasive manoeuvres. According to Türk et al., the indications for PCNL are stones with a surface >20 mm^2, staghorn and/or partial staghorn calculi, and stones in patients with chronic kidney disease (CKD), while contraindications for PCNL are pregnancy, bleeding disorders, and uncontrolled UTIs.[2]

Various nephrolithometry scores are commonly used to classify stone burden in patients. It is still debatable which one is the best. According to Kumar et al., both GSS and STONE scores have the same effectiveness in the prediction of procedure success rate4. Yarimoglu et al. compared the four scores and although none of the four offered any predictability regarding complications in that study, they revealed that GSS and S-ReSC systems were effective in the prediction of SFRs post-PCNL.[5] In a recent meta-analysis by Jiang et al. comprising 10 studies that tried to identify the usefulness and precision of GSS, CROES and STONE systems, the authors indicated that the three scoring systems were equally useful and had similar precision for predicting SFR after PCNL. Nevertheless, the only scoring system able to predict complications post-PCNL was GSS.[6]

Some authors used computer tomography (CT) scans in calculating the GSS with higher accuracy. In a cohort of 155 patients, Vicentini et al. used a preoperative CT scan for GSS to determine PNCL outcomes in the supine position.[7] According to the authors, the GSS calculated based on CT scans proved its usefulness in accurately evaluating post-PCNL outcomes and complications in relation to the stone. Although preoperative CT scans can provide more information regarding kidney anatomy and stone characteristics, plain KUB and intravenous urography have lower costs and are more frequently used in poorer countries where the medical system cannot afford to offer CT scans, but where there is a higher prevalence of urolithiasis.[7]

The overall and GSS-related SFR reported by different authors varies widely. In some cases it is lower compared to the current study. Thomas et al. reported in 100 PCNL procedures an overall SFR of 62%.[8] The highest rate (81%) was recorded for grade 1 and the lowest (29%) for grade 4.[8] Khalil et al. obtained an overall SFR of 77% out of 100 patients, with the highest SFR in patients with GSS1 (100%) and the lowest in patients with GSS4 (76.9%).[9] In a group of 445 patients, Kumar et al. reported a total SFR of 86.29%, but the difference between GSS groups was not significant. The authors had an SFR of 84.86% for GSS1, 89.25% for GSS2, 87.5% for GSS 3 and 82.35% for GSS 44. As in the current study, the majority of studies reported the highest SFR for GSS1 and the lowest for GSS4.[4,8,9]

Despite being a minimally invasive surgery and with a high SFR, PCNL does have complications.[9] Khalil et al. reported a 27% rate of complication. After determining the risk of complications by using the modified Clavien grading system and after determining the GSS, the study found a difference between GSS grades which were statistically significant, with the lowest incidence of complication in GSS1 (18.9%) and the highest in GSS4 (61.5%).[9] In 811 PCNLs, Tefekli et al. noticed perioperative complications in 29.2% patients; 33 grade 1 (4%), 132 grade 2 (16.3%), 54 grade 3a (6.6%), 23 grade 3b (2.8%), 9 grade 4a (1.1%), and 3 grade 4b (0.3%). Besides, there was 1 death (0.1%).[10] A meta-analysis of 10 studies reported that only GSS could predict post-surgical complications.[6]

According to Dindo and Clavien, the administration of antibioprophylaxs is categorised as grade 1, and not as grade 2, because they considered antibioprophylaxis a part of the procedure.[3,11] Furthermore, when they encountered high fever unresponsive to antipyretic medicine and which needed extra antibiotherapy, it was included in grade 2 complications. In the current study, perioperative antibioprophilaxy was given to all patients, and patients with fever after PCNL which was considered grade 1 were already on antibiotic drugs in line with the guildelines.[3,11]

Like many urological interventions, PCNL can be fraught with complications.[12] According to Seitz et al., there are some limitations when it comes to the classification of post-PCNL complications. These limitations arise because of the associated treatments in stone management, like second-look PCNL, ureteroscopy, and ESWL – which are part of the interventions and should not be included in the complication category.[12] The reported incidence of PCNL complications is very variable; from 52.5% to 16.2%.[13,14] In the current study, the complication rate was close to that reported by an earlier study.[15]

In a meta-analysis that included 115 studies, Seitz et al. showed that preoperative positive urine culture could be found in up to 66.1% patients and positive stone culture in 46.4%. This can lead to postoperative transitory fever in 32.1% patients and symptomatic UTI in 3.5%.[12] According to Choi et al., pre-existent UTI is an independent predictor for SFR besides the number of involved calyces and STONE nephrolithometry.[16] In the current study, patients in GSS4 group had the highest incidence of preoperative positive urine culture. This combination could be an explanation for the lowest SFR in this category of patients.

UTI is a common finding in patients with urolithiasis. According to Gutierrez et al., UTI-associated fever is a frequent complication after PCNL, and it can appear in 21-39.8% patients.[17] UTIs increase the risk of urosepsis, and it can increase the cost of treatment.[18] This is one of the reasons why the European Association of Urology (EAU) guidelines advise antibiotherapy before the procedure for all cases of PCNL, and it should be maintained 4 days postoperatively in patients with stones caused by infection, a very recent UTI, or positive urine cultures.[2] Despite this, in a total of 5803 patients that received antibiotic prophylaxis, Gutierrez et al. reported that post-PCNL fever appeared in 18.2% of those with a positive preoperative urine culture and 8.8% of those with sterile urine cultures.[17] This shows that a positive urine culture can increase the risk of post-PCNL fever twofold.[17] In a group of 217 patients, Sharifi Aghdas et al. reported a rate of post-PCNL fever of 50% that had positive urine cultures and a rate of 33% in the group with negative rine cultures.[19] One study concluded that fever on its own cannot be considered a sign of systemic infection.[17] Rao et al. investigated 117 patients who underwent PCNL, nephrostomy installation, ureteroscopy, the push-back or push-bang procedure for ureteral stones, and reported that while 74% developed post-PCNL fever, only 41% presented endotoxemia.[20] According to Draga et al., transient post-PCNL fever can be explained as a systemic answer to the surgery and resorption of the post-PCNL haematoma.[21] In the current study, only urine from the bladder was used for urine cultures, which is a limitation, as Korets et al. have suggested that urine cultures using samples from the renal pelvis and stone cultures can be more useful in determining the microorganism involved in the UTI, and to direct the antibiotic therapy accordingly.[22]

The spectrum of urine culture microorganisms in lithiasis patients can be very variable and it is important not only for antibiotic prophylaxis, but also for the relapse of the kidney stone. In a total of 776 patients treated with PCNL, Paonessa et al. reported positive preoperative urine culture in 45.4%.[23] The most frequent microorganisms identified in preoperative urine culture were *staphylococcus, proteus,* and *E.coli*, while in the study by Gutierrez et al., the most identified germs were E.coli, proteus and *klebsiella*.[16] In the current study, the most frequently encountered germ was *E.coli*, followed by *klebsiella* and *proteus*. This finding was interesting because the most encountered germ in all patients in our urological clinic is *klebsiella*.[24]

Conclusions

E. Coli was far more frequent than proteus in urine culture, indicating that infected stones are more frequent than infectious stones. UTIs are often found in patients with higher GSS grades and could lead to more infectious complications post-PCNL. GSS remains a useful tool in predicting the immediate success rate of PCNL and is also helpful in preoperative patient counselling. Although antibiotic prophylaxis should be mandatory, it may not be useful in preventing infectious complications during or after PCNL. Most complications, however, can be treated conservatively, but with a longer hospitalisation and a longer antibiotherapy.

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