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ORIGINAL PAPER

Disruptions in Renal Stone Management during the COVID-19 Pandemic: a Retrospective Single-Center Study

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ABSTRACT

Objectives: *This study evaluated changes in renal stone management during the COVID-19 pandemic in a single center, focusing on treatment methods, patient outcomes and healthcare delivery models.*

Materials and methods: *We conducted a retrospective analysis comparing patients treated for kidney stones between July–September 2019 (pre-pandemic period) and July–September 2020 (pandemic period). We assessed the number of treated patients, treatment modalities and postoperative outcomes.*

Results: *A total of 77 inpatients were analyzed, of whom 50 had been admitted to hospital during the pre-pandemic period and 27 during the pandemic, which represented a 46% decrease in hospitalizations. There were no significant differences in body mass index, average age, stone laterality, size, or location. Serum creatinine levels and positive urine cultures were also comparable between the groups. A trend toward more minimally invasive procedures was observed during the pandemic, with an increased use of flexible ureteroscopy (62% vs. 70.4%) and a decrease in percutaneous nephrolithotomy (12% vs. 7.4%). Operative times and hospital stays were similar across groups. However, the stone-free rate significantly decreased during the pandemic (91.1% vs. 84.07%).*

Conclusions: *The COVID-19 pandemic significantly disrupted renal stone management, leading to a preference for minimally invasive surgery but a lower stone-free rate.*

Keywords: renal stone, COVID-19, flexible ureteroscopy, ureteroscopy, percutaneous nephrolithotomy.

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INTRODUCTION

The condition known as nephrolithiasis describes the formation of stones consisting of deposits of salts and minerals within the kidneys (1). When these stones leave the renal pelvis and travel through the rest of the urinary tract, the result is a disorder known as urolithiasis. Some patients with urolithiasis can be treated with anti-emetics, painkillers and medical expulsive therapy. However, more invasive measures are required when stones cause obstruction, renal failure, or infection (2).

Lifestyle variables, including a decline in physical activity, changes in food habits and changing climates, are associated with the significant rise in the incidence of kidney stones over the last several decades, which has been observed in both developed and developing nations (3). Renal stones are a prevalent health condition in the world's developed nations, with a lifetime frequency of 10–12% in males and 5–6% in females (4). According to epidemiological research, the prevalence of kidney stone disease ranges from 0.1 percent to 18.5 percent, with rates as high as 25 percent in developing countries (5, 6). Given these high prevalence rates, urolithiasis has emerged as a global public health issue (7).

Even before the pandemic, urological organizations provided standard protocols and evidence-based recommendations for managing renal stones. Patients with urinary tract stones are quickly treated with painkillers. Paracetamol has become the drug of choice for treating renal colic in medical practice, as non-steroidal anti-inflammatory drugs (NSAIDs) have a higher risk of side effects in some patient groups (8).

The treatment landscape relied on various effective procedures, including semirigid ureteroscopy (URS), flexible ureteroscopy (fURS) and extracorporeal shock wave lithotripsy (ESWL), with optimal anesthesia tailored to each patient's condition. This structured management enabled healthcare providers to maintain high standards of care for patients suffering from urolithiasis before the disruptions caused by the COVID-19 pandemic. Delayed treatment in such cases can lead to increased pain and discomfort for patients, as well as a higher risk of developing complications like infections or kidney damage. Prolonged obstruction can also impair kidney function, potentially resulting in long-term health consequences. Therefore, timely intervention is crucial to prevent these adverse outcomes and maintain patient well-being (9, 10).

The pandemic of coronavirus disease 2019 (COVID-19) has changed the healthcare landscape worldwide and is forcing extraordinary adjustments in medical practice, including the management of renal stones. Traditional protocols for renal stone management were well-established before the pandemic. However, the advent of COVID-19 brought stringent austerity measures in healthcare services, delaying elective surgeries, transitioning to telemedicine consultations, and altering patient presentation. In the United States and other regions, the impact of COVID-19 resulted in a decline in emergency room visits, an elevated incidence of acute renal injury among patients, significant delays in outpatient clinic appointments and a transition to virtual or telephonic consultations (11). A significant backlog in treatment is expected as a result of these adjustments due to a lack of in-hospital beds, anesthetic procedural slots and medical personnel (12).

We aimed to retrospectively evaluate the effect of these modifications on managing renal stones at a single center and investigate the impact of the COVID-19 pandemic on treatment protocols, patient-derived outcomes, and the healthcare delivery model. By comparing pre- and post-pandemic management, this study aims to provide essential insights into renal stone care during a major global health emergency. As the medical field grows, these insights will be necessary for patients and healthcare workers. ❑

MATERIALS AND METHODS

This single-center retrospective study was conducted according to the regulations of the Declaration of Helsinki after obtaining the approval of the hospital's Bioethics Committee. Participation in the study was contingent upon the patients' regular and explicit permission to use their anonymous treatment records for research. In the present study we included patients over 18 years old who were hospitalized in the Urology Department of "Saint John" Emergency Clinical Hospital, Bucharest, Romania. We analyzed the patients treated for kidney stones be-

tween July and September 2019 (pre-COVID-19 era) and compared them with the hospitalized patients in the same period, July–September 2020, during the pandemic (COVID-19 era). During the pandemic, the urological healthcare system in Bucharest underwent extensive restructuring. The peak daily number of coronavirus cases in Romania during this time was 2,158 (13). Our hospital operated in a mixed regime during this period, treating both negative and positive coronavirus patients. Only patients with a confirmed negative PCR test for COVID-19 were included.

Data collected included age, sex, body mass index (BMI), stone laterality, length of hospital stay, surgery duration, stone size and location, serum creatinine levels, type of surgery performed (ureteroscopy or percutaneous nephrolithotomy) and urine culture results. In addition, urinary tract ultrasonography and low dose computed tomography were performed to strengthen the diagnosis and establish the stones' characteristics.

Continuous variables are represented as mean and standard deviation, whereas categorical variables are expressed as frequencies and percentages. For categorical variables, Chi-square analysis or Fisher's exact test was applied. For comparing continuous variables, Student's t test was utilized. We regarded a p-value <0.05 to be indicative of statistical significance. Statistical analysis was performed on all data using SPSS version 20 (IBM Corp, Armonk, NY, USA). ❑

RESULTS

Our analysis included 77 patients hospitalized in the Urology Department of "Saint John" Hospital, Bucharest, Romania, due to urolithiasis. The female-to-male ratio among these patients was 42:35. The key characteristics of patient groups involved in the present study are summarized in Table 1. There was a significant difference in the number of hospitalizations, which decreased by 46%: 50 hospitalizations in the pre-COVID era in 2019 compared to 27 during the COVID era in 2020. Patients' mean age did not show a statistically significant difference between the two periods, with an average age of 53.72 years (SD 15.854) in the pre-pandemic period and 55 years (SD 17.901) in the COVID-19 period ($p = 0.748$). Also, no differences were found between the two arms of the study regarding body mass index (BMI), laterality of the stones, their size and location. Despite the reduction in hospitalizations, there were no significant differences in serum creatinine levels between the two groups. The average serum creatinine level was 1.098 mg/dL in the pre-COVID group and 1.190 mg/dL in the COVID-19 group ($p=0.416$). Additionally, there were no significant differences in positive urine cultures, with 14 cases (28%) in the pre-COVID-19 group compared to 11 cases (40.7%) in the COVID-19 group ($p=0.255$) (Table 1).

Our findings showed a significant change in the number of hospitalized patients with renal

TABLE 1. Characteristics of patients admitted with a diagnosis of nephrolithiasis in July-September 2019 and 2020

	Pre COVID-19 era	COVID-19 era	P-value
No	50	27	
Sex			
Male	20 (57.1%)	15 (42.9%)	0.191[1]
Female	30 (71.4%)	12 (28.6%)	
Age means	53.72 (±15.854)	55 (±17.901)	0.748[2]
BMI (kg/m^2)	27.74 (±1.915)	27.29(±3.024	0.427[2]
Stone side			
Left	19 (3 %)	16 (59.3%)	0.095[1]
Right	31 (62%)	11 (40.7%)	
Stone size	15.84±8.462	17.59±10.707	0.433[2]
Stone location			
Renal pelvis	23 (46 %)	12 (44.4%)	0.820[3]
Staghorn	4 (8%)	4 (14.8%)	
Inferior calyx	18 (36%)	10 (37%)	
Middle calyx	3 (6%)	1 (3,7%)	
Superior calyx	2 (4%)	0 (0%)	
Creatinine (mg/dL)	1.098±0.488	1.190±0.439	0.416[2]
Positive urine culture >10^5 CFU	14 (28 %)	11 (40.7%)	0.255[1]

1=Chi-square test; 2=Student's test; 3=Fisher's exact test. CFU=colony-forming units; COVID-19=coronavirus disease 2019; No=number

	Pre Covid-19 era	Covid-19 era	P-value
Type of intervention			
URS	13 (26%)	6 (22.2%)	0.724[1]
FURS	31 (62%)	19 (70.4%)	
PCNL	6 (12%)	2 (7.4%)	
SFR (%)	91.1 (±13.63)	84.07 (16.17)	0.047[2]
Surgery time (minutes)	54.62±16.281	57.15±17.351	0.527[2]
Duration of hospital stay (days)	3.72±1.371	3.89±1.761	0.643[2]

1=Chi-square test; 2=Student's test. URS=ureteroscopy; FURS=flexible ureteroscopy; PCNL=percutaneous nephrolithotomy; SFR=stone-free rate.

TABLE 2. Management of renal stones

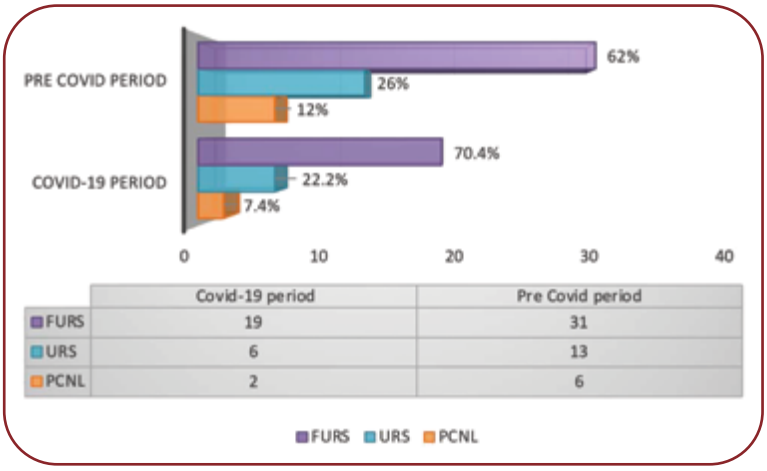

FIGURE 1. Management of patients during the pre-pandemic and pandemic periods

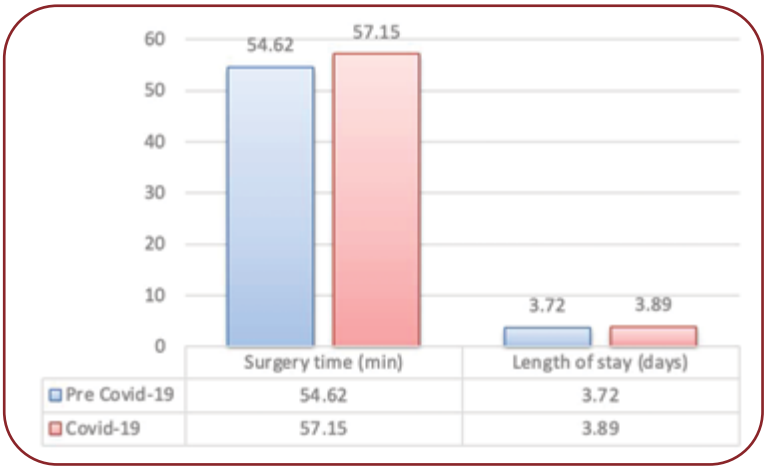

FIGURE 2. Management characteristics during the pre-pandemic and pandemic periods

lithiasis during the pandemic. However, the percentage of endoscopic surgeries did not differ statistically significantly. There were thirteen (26%) and six (22.2%) semirigid ureteroscopies in the pre-pandemic and pandemic periods, respectively, p=0.724 (Table 2). Also, regarding the differences between treatment modalities, we observed a trend towards minimally invasive interventions such as flexible ureteroscopy over percutaneous nephrolithotomy (62% *vs* 70.4%), respectively (12% *vs* 7.4%) between the two periods (Figure 1). Furthermore, we found no statistically significant differences in operating time (54.62 min *vs* 57.15 min) or length of hospitalization (3.72 days *vs* 3.89 days) (Figure 2). The stone-free rate (SFR) showed a statistical difference, averaging 91.1% for the pre-pandemic period and 84.07% for the pandemic period (p=0.047) (Table 2). ❑

DISCUSSION

The COVID-19 pandemic has profoundly impacted global health, and Romania has been no exception. The first case of COVID-19 in Romania was reported on the 26th of February 2020, and since then, the country has experienced multiple waves of the virus with varying levels of severity and impact, leading to a dramatic shift in the national healthcare system (14). Many illnesses went untreated despite efforts to maintain care, particularly for emergencies and cancer cases (11). Urology, like many other medical specialties, has experienced significant impacts from the COVID-19 pandemic. This includes a decline in elective procedures and outpatient visits and the necessity, in some cases, to reallocate resources and staff to frontline departments (15). While several urological societies have published guidelines for managing urological diseases during this time, no studies have been conducted to evaluate how the pandemic has changed routine practices in the field (16). Consequently, we set out to examine the effects of the COVID-19 pandemic in our region on nephrolithiasis-related admissions, hospitalizations, and urologic treatment. Our hospital is situated in Bucharest, the capital of Romania, which is one of the regions most affected by illness rates.

The impact of the pandemic on kidney stone management is a major concern, requiring a comprehensive approach to both urgent and elective cases. To prevent disastrous outcomes, we must improve our comprehension of urolithiasis presentation and care during pandemics (17). Urologists should regularly monitor patients with kidney stones and prioritize those who require immediate medical attention (18). The temporary suspension of elective surgeries has led to a significant backlog of procedures. During this time, urologists were instructed to prioritize their patients, manage treatments as efficiently as possible, and utilize telemedicine (19). The effort to identify patients with the highest priority is commendable. One notable example is the triage approach suggested by Chen *et al*, which considers symptoms such as blockage, infection and kidney failure (20). In contrast to obstructive or infectious urolithiasis, which requires immediate treatment, nonobstructive kidney stones can often be managed with a delay in intervention. However, postponing treatment may lead to a decline in the patient's quality of life and increased distress. This is because patients might face challenges related to managing percutaneous nephrostomy, along with anxiety and discomfort from the stent for an extended period. Furthermore, if the stone continues growing, the patient may require a more complex or invasive procedure later. Therefore, priority should be given to patients experiencing symptoms of urolithiasis and those who already have existing stents (21).

Our study showed a 46% decrease in nephrolithiasis-related hospitalizations compared to the periods examined by us. These results closely align with those reported by Antonucci *et al* in a study conducted in Italy, which observed a 48.8% reduction in urolithiasis hospitalizations between 2019 and 2020 during the March-April period (16). Novara *et al* found a 55% reduction in urological emergencies presented to the emergency room over one week in 2020 compared to 2019 (22). Other studies also report a significant reduction in the number of inpatients with kidney stones (11, 23-26). These data align with additional reports of other clinical conditions, which may be explained by individuals avoiding hospital visits due to fear of contracting the virus (27). In contrast to these results, Medina *et al* describe no differences in the number of surgeries between the pre-pandemic and pandemic periods (17).

Chemolysis and medical expulsive therapy (MET) have emerged as important alternatives to surgical procedures in some instances. In situations where pain relief from analgesics is insufficient or when there is concurrent uremia, anuria, or a life-threatening case of urosepsis, prompt renal drainage is essential for treating acute renal colic (11, 17, 28). Due to the high risk of accidental dislodgement and delays in surgical intervention, some authors recommend avoiding percutaneous nephrostomy procedures. Instead, when feasible, local anesthesia to insert a double J stent or percutaneous nephrostomy tube is suggested, as it can help conserve intensive care equipment and personnel (15, 29).

Although few studies have been conducted, antibiotic prophylaxis appears to lower the risk of urosepsis, particularly in patients with stents, when endoscopic interventions are postponed due to the pandemic (29, 30). Our data indicate that during the COVID-19 era, 40.7% of patients experienced urinary tract infections, compared to 28% in the pre-COVID-19 period, although this difference was not statistically significant. Additionally, there has been ongoing debate regarding the retention of double J stents, with some advocating for their extraction or exchange while others suggest postponing these procedures(31).

During the pandemic, the waiting time for endoscopic interventions significantly increased. A study by Medina *et al* reported that the average waiting time rose from 46.5 days in the pre-COVID-19 period to 72 days during the pandemic (17). However, they found no statistically significant differences in age, sex, stone size, type of procedure, operative time, or residual stone fragments. Our findings are consistent with theirs, with one exception: we observed a decrease in the stone-free rate, which fell from 91.1% before the pandemic to 84.07% during the pandemic. We attribute these results to the growing preference for less invasive approaches in treating large stones. Factors such as shorter hospital stays, lower complication rates and patient preferences have decreased percutaneous nephrolithotomy (PCNL) from 12% in the pre-pandemic period to 7.4% during the pandemic. In contrast, there has been an increase in FURS interventions. Technological advancements, in-

cluding developing flexible single-use endoscopes with a suction sheath, have enhanced the treatment of stones larger than 2 cm using a minimally invasive approach. These innovations have led to improved intraoperative image quality and a lower rate of residual fragments. According to a study by Cozma *et al*, the stone-free rates for stones larger than 2 cm after a second session of FURS are comparable to those of PCNL, reporting 88.8% and 90.4%, respectively (32). However, while the benefits of minimal invasiveness and shorter hospitalization times are clear, they come with higher intervention costs and may require multiple sessions to remove the stones altogether.

Our data indicates no significant differences in the stone size between the pre-pandemic and post-pandemic eras. Additionally, we did not observe any differences in the laterality or location of the stones. Similar findings have been obtained in other studies (11, 31, 33, 34). On the other hand, Jiang *et al* found that during the pre- and post-COVID eras, the average stone size went up from 5.1 to 10.5 mm. According to the authors, this is because the epidemic dramatically affected patients' choices for urolithiasis therapy (35).

A recent study conducted by Mazzon *et al* in Italy across nine centers reported similar findings regarding reducing elective surgeries for urolithiasis during the COVID-19 pandemic. The study compared data from 12 months before the pandemic to the same period during the pandemic and found a 21.09% decrease in procedures, with the number of surgeries falling from 1,622 to 1,280. This reduction included ESWL, URS, FURS and PCNL (21).

Overall, the research indicated no significant changes in surgical quality between the two periods, except for the SFR, which was attributed to the increased shift from PCNL to FURS.

However, it is important to acknowledge that this study has several limitations. First, its retrospective design introduces a potential bias in data analysis. Additionally, the small sample size and the fact that it was conducted in a single center are significant constraints. Finally, the absence of results from the post-pandemic period is a notable gap. Therefore, future studies are necessary to help us understand the long-term impact of the pandemic. ❑

CONCLUSIONS

Our investigation demonstrated how the COVID-19 pandemic in Bucharest has significantly disrupted the treatment of kidney stones. There were more patients with urinary tract infections, probably because they delayed presenting to the hospital. More patients are undergoing minimally invasive surgery, which may have contributed to a decrease in the stone-free rate. ❑

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