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Egyptian urinary stones in the COVID-19 outbreak: a multi-center study

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Abstract

Background Urolithiasis is a unique disease that can cause emergencies and can impair kidney function over time, especially if infections overlap. This work aimed to compare urolithiasis in the pre- and post-pandemic era and to study the impact of the COVID-19 pandemic on patient preferences and decision-making for symptomatic urolithiasis and consequently complications.

Methods This case–control multi-center study was conducted at the Urology Department of two tertiary centers in XXX. Participants were divided into two groups: group A: patients who had urolithiasis from March 1, 2018, to February 29, 2020 (pre-COVID-19 period), and group B: patients who had urolithiasis from March 1, 2020, to February 28, 2022 (during COVID-19 period).

Results Group A had a significantly higher incidence of percutaneous nephrolithotomy (PCNL) without double J stenting (DJ), nephrolithotomy + pyelolithotomy and total PCNL compared to group B which had a lower incidence of URS without DJ and total URS. The operation was delayed among 72 (15.9%) patients during the pandemic. In total, 116 (25.6%) were subjected to previous stone removal surgery. In total, 59 (13%) of patients had COVID-19 infection before stone diagnosis. One hundred thirty-two patients (29.1%) were on vitamin C. The presence of positive family history was statistically significant in patients who underwent ESWL in comparison with patients who underwent endoscopy or surgery ($P=0.03$).

Conclusions COVID-19 significantly impacted endourological services for urinary stones in terms of surgical volume and case complexity.

Keywords Urinary stones, COVID-19, Vitamin C

1 Background

COVID-19 restrictions influenced the emergency admissions of patients with acute renal colic with a concurrent increase in the rate of infectious stones. One possible explanation is that some patients in need of immediate medical attention did not report to the emergency department or arrived later than usual before the pandemic, reporting more severe symptoms [1].

Vitamin C has anti-infective characteristics and can play a protective role in the current pandemic of COVID-19 by immune system boosting. Being a strong antioxidant, vitamin C promotes normal neutrophil function, oxidative species scavenging, vitamin E regeneration, signaling pathway modulation, enhanced neutrophil motility to the infection site, activation of pro-inflammatory transcription factors, signaling cascade activation, nuclear factor B (NFB), control of inflammatory mediators, gene regulation, phagocytosis, and T-cell signaling pathways. These roles are critical for COVID-19 infection prevention and treatment. Daily normal individual requirements of vitamin C are about 200 mg. Infection increases the need for vitamin C, and in this situation, 1–2 g/day is advised [2].

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Intake of vitamin C from diet was not linked to stones in either gender. In males, but not in females, total and supplemental vitamin C intake was substantially linked to an increased risk for incident kidney stones. Men who develop calcium oxalate stones should avoid vitamin C supplements, but vitamin C intake in the diet [3].

Lim et al. [4] evaluated the clinical changes and histopathologic outcomes of newly diagnosed kidney diseases as indicated by kidney biopsy after receiving the COVID-19 vaccination.

This work aimed to detect how the COVID-19 epidemic has affected urinary stone presentation of the effect of vitamin C supplementation in outpatient clinics and emergency departments and whether the delay in seeking medical advice led to urinary complications as well as to detect the impact of COVID-19 vaccines and long-term daily use of face mask on fluid intake on urinary stone formation.

2 Methods

This is a retrospective multi-center study that included 1330 patients with urolithiasis. Patients are divided into two groups: group A ($n=876$): patients who had urolithiasis from March 1, 2018, to February 29, 2020 (pre-COVID-19 period), and group B ($n=454$): patients who had urolithiasis from March 1, 2020, to February 28, 2022 (during COVID-19 period). Exclusion criteria were patients with missed data, children, and pregnant females.

Approval of the Ethical and Research Committee of the Urology Department, Faculty of Medicine, was taken before the start of this study. Every patient who was part of the study received a call for follow-up, instructions to visit the outpatient clinic, and information on the goal of the study to ensure they complied with their consent.

All patients in both groups were asked about their name, age, residence, occupation, general medical condition (diabetic, hypertensive, renal failure, cancer, or hyperparathyroidism), daily fluid intake, stone density, site of the stone, congenital anomalies in the urinary system, family history of stones, previous history of stone formation, operations performed for stone extraction either by surgery or by endoscopy.

Group B patients were asked about COVID-19 diagnosis before being diagnosed with stones, the regular wearing of face masks while performing their outdoor activities during the COVID-19 pandemic, intake of vitamin C during the COVID-19 period (duration and reason), if anxiety related to COVID-19 infection caused those patients to postpone their procedures, whether this enhanced their reliance on medical expulsive treatment and their chance of unfavorable outcomes.

During the second year of the pandemic, patients were asked questions about their vaccination status and type every time patients were admitted.

After discussing the essence of the disease, the complications, and possible benefits of the research and the procedure, each patient signed an informed written consent form.

The Social Sciences Statistical Package (SPSS) release 26 was used to code and enter the data (IBM Corp., Armonk, NY, USA). Statistics were employed to interpret the data in terms of frequencies (the number of occurrences) and percentages. The Chi-square (2) test was used to compare both groups. Statistics were considered to be of statistical significance if P -values < 0.05 .

3 Results

The demographic information was comparable across groups. While group B had a lower incidence of ureteroscopy (URS) without DJ and total URS, group A had a significantly greater incidence of percutaneous nephrolithotomy (PCNL) without DJ stent, nephrolithotomy with pyelolithotomy, and total PCNL.

Table 1 shows patients' characteristics and the incidence of different operations. Data are presented as frequency (%). DJ: double J stenting, PCNL: percutaneous nephrolithotomy, URS: ureteroscopy. * P -value < 0.05 is considered to be statistically significant.

Table 1 Patient characteristics and the incidence of different operations

	Group A	Group B	p-value	
Age (years) median (range)	40 (21–72)		–	
Sex n (%)	Total	876	651	
	Male	594 (67.8%)	406 (62.4%)	??
	Female	282 (32.2%)	245 (37.62%)	
Stone n (%)	Total	2684	2142	0.004
	Yes	786 (29.3%)	548 (25.6%)	
	No	1898 (70.7%)	1594 (74.4%)	
Incidence of different operations n (%)	Total	($n=876$)	($n=651$)	
	Cystolitholapaxy	95 (10.8%)	48 (7.4%)	0.021
	PCNL + JJ	52 (5.9%)	49 (7.5%)	0.216
	PCNL without JJ	390 (44.5%)	234 (35.9%)	0.001*
	URS without JJ	83 (9.5%)	161 (24.7%)	$< 0.001^*$
	URS + JJ	187 (21.3%)	139 (21.4%)	0.998
	Nephrolithotomy + pyelolithotomy	45 (5.1%)	3 (0.5%)	$< 0.001^*$
	Ureterolithotomy	7 (0.8%)	6 (0.9%)	0.981
	Cystolithotomy	8 (0.9%)	7 (1.1%)	0.956
	Total URS	277 (31.6%)	301 (46.2%)	$< 0.001^*$
Total PCNL	444 (50.7%)	285 (43.8%)	0.008*	

* Statistically significant

The incidence of admission of patients with urolithiasis was significantly higher in the pre-COVID-19 group [786 (29.3%)] compared to the post-COVID-19 group [548 (25.6%)]. When COVID-19 was widespread, the rate of admission of patients suffering from urolithiasis decreased especially during the first year of the pandemic; then, the admission rate began to return to the normal rate of admission during the second year of the pandemic.

Table 2 shows the number of patients suffering from urolithiasis who had performed their operation two years before and two years during the pandemic of COVID-19.

Omitted data caused the exclusion of certain cases (wrong phone number or not answering their phone although calling them many times or not cooperative in providing accurate information about the patient). Pregnant females and children were also excluded. The total number of patients in group B after exclusion was 454. Figure 1 shows a flow chart of patients in group B.

The operation was delayed among 72 (15.9%) patients during the pandemic. In total, 116 (25.6%) were subjected to previous stone removal surgery. In total, 59 (13%) of patients had COVID-19 infection before stone diagnosis. Taking vitamin C during the COVID-19 pandemic was among 132 (29.1%).

Table 3 shows the delay in performing the operation and wearing a mask during COVID-19, history of stone formation and stone removal surgeries, family history, intake of vitamin C, and infection with COVID-19 in group B.

The presence of positive family history was statistically significant in patients who underwent ESWL in comparison with patients who underwent endoscopy or surgery ($P=0.03$). Table 4 demonstrates a connection between stone density and ancestry.

The vaccinated patients before being diagnosed with stone formation were 28 (10.2%). AstraZeneca vaccine was administered to 12 (63.2%) patients, Pfizer vaccine was administered to 2 (10.5%) patients, and Sinopharm was administered to 5 (26.3%) patients. Table 5 shows vaccinated individuals before being diagnosed with stone formation.

4 Discussion

Our study found that during the COVID-19 pandemic's first two years, the rates of admission of patients from the outpatient clinics for the performance of invasive procedures related to stones in urology departments were found to be significantly lower than the pre-COVID-19 duration (previous 2 years); this was probably due to refusal of many patients to be admitted to hospitals and their preference to perform less invasive procedures like percutaneous nephrostomy (PCN) insertion and extracorporeal shockwave lithotripsy (ESWL) or even utilization of medical expulsive therapy, e.g., alpha-blockers as a home treatment, and the government issued specific directives to decrease the number of elective procedures in various surgical departments, including urology departments and stone operations, due to the necessity to reallocate labor and resources to frontline departments during the COVID-19 pandemic.

Naspro and Da Pozzo [5] documented a 30% fall in urological surgical volumes within 15 days from the start of the outbreak. The same authors reported a total shutdown on March 19, 2020. This fact was determined by the utilization of hospital beds for COVID-19 patients. The ability to perform urgent urological procedures was also severely hampered by the dearth of anesthesiologists, operating rooms, and ventilators that were required to care for acute COVID-19 patients [6, 7].

Moreover, Novara et al. [6] stated that there was a 55% reduction in urgent consultations in Italy, with a peak of 64% in areas massively affected by the COVID-19 outbreak. Similar results were reported by Raheem et al. [7] in the Saudi Arabian Kingdom. Overall, the authors observed a 78% decline in outpatient clinic appointments (with 90.8% of them delivered as telephone consultations) and 34% for all elective procedures. Additionally, emergency procedures decreased by 9.3%.

The rate of ESWL and medical expulsive therapy increased during the COVID-19 pandemic [8]. As a result of these treatment modalities, the rate of

Table 2 Number of patients with urolithiasis who had performed their operation two years before and two years during the COVID-19 pandemic in Nasser Institute

Year	March 1, 2018, to February 28, 2019	March 1, 2019, to February 29, 2020	March 1, 2020, to February 28, 2021 (1st year of a pandemic)	March 1, 2021, to February 28, 2022 (2nd year of a pandemic)
Number of patients with urolithiasis admitted to Nasser Institute	420	366	209	339

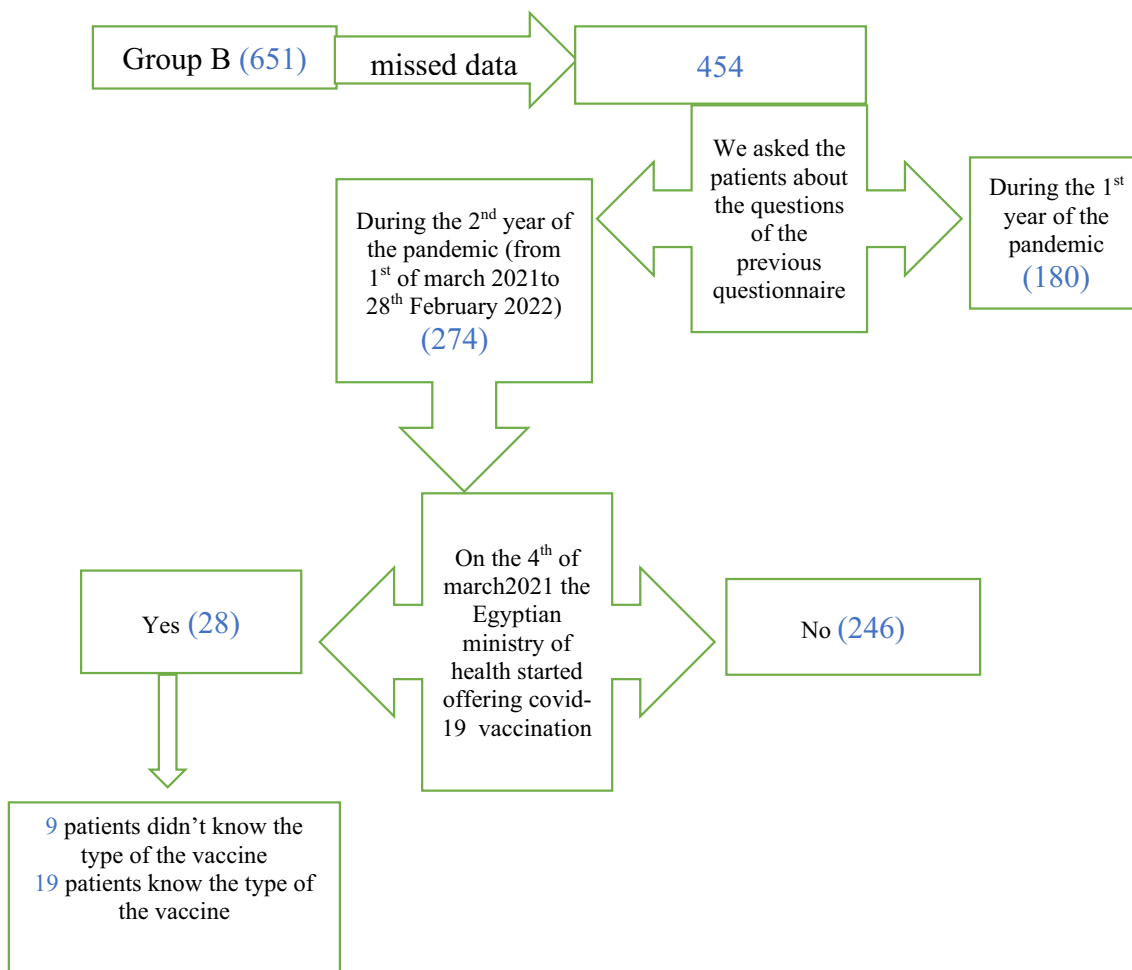


Fig. 1 Flow chart of patients in group B

Table 3 Delay in performing the operation and wearing a mask during COVID-19, past history of stone formation and stone removal surgeries, family history, COVID-19 infection, and vitamin C intake in group B

	Group B (N=454)
Delay in operation	72 (15.9%)
Wearing mask	95 (20.9%)
Stone formation	225 (49.6%)
Previous surgery	116 (25.6%)
Family history	132 (29.1%)
COVID-19 infection	59 (13%)
Vitamin c intake	132 (29.1%)

Data are presented as frequency (%)

disintegration and extraction of ureteric stones using URS were significantly higher than that in the pre-COVID-19 era. A statistically significant difference was found in the results ($p=0.000$).

Table 4 Relation between stone density and family history

	Patients with radiopaque stones who underwent ESWL (n=50)	Patients for whom we do not know their stone density (underwent endoscopy or surgery) (n=454)	p-value
Positive family history	22 (44%)	132 (29.1%)	0.030*

Data are presented as frequency (%). ESWL: extracorporeal shock wave lithotripsy. * $p < 0.05$ is statistically significant

Our results were supported by the study of Mazzon et al. [9] who held a retrospective study involving three tertiary referral centers for urolithiasis across China. They assessed the surgical output and postoperative results of surgeries carried out to treat upper urinary tract stones. They compared the trimester before restrictions for COVID-19 (October 1, 2019, to December 31,

Table 5 Vaccinated individuals before being diagnosed with stone formation

<i>N</i> = 274	
Vaccination	
No	246 (89.8%)
Yes	28 (10.2%)
<i>N</i> = 19	
Types of vaccine	
AstraZeneca	12 (63.2%)
Pfizer	2 (10.5%)
Sinopharm	5 (26.3%)

Data are presented as frequency (%)

2019, period A), during restrictions (February 1, 2020, to March 31, 2020, period B), and afterward (April 1, 2020, to June 31, 2020, period C).

Regarding ESWLs, after the COVID-19 appearance, the proportion of ureteric stones increased significantly, accounting for 70.1% in period A, 87.9% in period B, and 78% in period C ($p=0.019$). Contrary to our findings, Byrne et al. [8] reported that among a total of 3755 patients, pre-pandemic were 1963 patients and during the pandemic were 1792 patients.

The rate of ureteroscopy (56.7% vs. 47.7%, $p<0.01$) was lower during the COVID-19 pandemic. During the pandemic time, the rate of ureteroscopy without DJ was higher than that in the era prior to COVID-19 and it was statistically significant ($p=0.000$). This is probably due to the preference of some urologists not to insert DJ after a successful ureteroscopy to minimize the risk of infection with COVID-19 during the follow-up visits for stent removal and to decrease the economic burden on the patient during the pandemic. Byrne et al. [8] found that stent insertion (67.9% vs. 54.5%, $p>0.001$) was lower during the COVID-19 pandemic.

Following a successful procedure, stent-free surgeries were advocated during COVID-19, and if stents were necessary, many urologists thought of employing stents with strings outside the urethra that could be removed as an outpatient procedure [10].

Unless there is an infection or staged therapy is planned, some endourologists prefer definitive stone treatment over temporary drainage to lower the number of ER visits and hospitalizations [10]. However, there was a decline in the rate of PCNL during the pandemic time, and this was statistically significant ($p=0.008$); this is probably due to the increased rate of ESWL at the expense of PCNL as many patients preferred to undergo ESWL as it is a day case procedure or because PCNL operations require general

anesthesia, long hospital stay, and sometimes a blood transfusion. Our results were supported by the study of Mazzon et al. [9]. During the pandemic of COVID-19, the cystolitholapaxy rate decreased and this was statistically significant ($p=0.021$). We lack a convincing explanation for that open kidney surgery (pyelolithotomy and nephrolithotomy) rates dropped, and they were statistically significant ($p=0.00$) as they need a prolonged stay in the hospital. Regarding ureterolithotomy and cystolithotomy rates are decreased during the pandemic time, but it was not of any statistical significance.

Our study showed that, during the first year of the pandemic, only 9% of patients have been infected with coronavirus before being diagnosed with urolithiasis, while by the second year around 15.7% of patients had been infected with coronavirus before being diagnosed with urolithiasis.

A long time ago, it was found that vitamin C can help prevent and treat pneumonia and sepsis. Patients suffering from sepsis, pneumonia, or multiple organ failure were found to have low vitamin C levels and higher levels of oxidative stress.

Numerous physiological processes carried out by vitamin C have relevance to COVID-19. These consist of immunomodulatory, anti-inflammatory, antithrombotic, and antioxidant processes. Many functions of vitamin C seem to be associated with cytokine storm, acute respiratory distress syndrome (ARDS), and sepsis associated with COVID-19 [11]. Regarding our study, 29.1% of the patients admitted to the urology departments during the COVID-19 pandemic were taking vitamin C.

According to kidney biopsy results that were validated following COVID-19 vaccination, Lim et al. report the clinical developments and histopathologic findings of newly diagnosed kidney illnesses. However, when treating individuals who have renal symptoms, practitioners must take into account the likelihood that immunizations could lead to kidney illness [4].

In our study, during the COVID-19 pandemic, 29% of patients had a positive family history of stones. According to research by Unno et al. [12] using prospectively collected data from the Japanese Registry for Stones of the Kidney and Ureter, 603 of 1566 patients (or 38.5%) had a positive family history of urinary stones.

The main restrictions in this study were the relatively small number of patients with available data due to poor registration of cases, ESWL unit was out of order in the other hospital during the target period of our study, and there was no registration of cases in ESWL unit during the pre-COVID-19 era or in the first year of the pandemic in King Fahd Unit.

5 Conclusions

COVID-19 significantly impacted endourological services for urinary stones regarding the volume of surgery and complexity of cases. A divergence from pre-COVID-19 standard practices has been seen, as well as a decline in the number of treated patients. Additionally stated, the long-term effects of these occurrences remain unclear and will ultimately necessitate further study.

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All authors have read and approved the manuscript.

Author contributions

SK, MGE, GME helped in conceptualization, methodology, resources, supervision, validation, and visualization. SK, ME, GME contributed to data curation, investigation, and writing—original draft. ME and SK were involved in formal analysis. None acquired the funding. SK helped in project administration and software. SK, ME, MGE, GME contributed to writing—review & editing.

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Availability of data and materials

The datasets used and/or analyzed during the current studies are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Cairo University, Egypt. The ethics committee code is MS-235-2022. After discussing the essence of the disease, the complications, and possible benefits of the research and the procedure, each patient signed an informed written consent form.

Consent for publication

All patients included in this research gave written informed consent to publish the data contained within this study.

Competing interests

The authors declare that they have no competing interests.

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