



# The impact of COVID-19 on acute urinary stone presentations: a single-centre experience

Steven Anderson<sup>1</sup> · Daniel McNicholas<sup>1</sup> · Claudine Murphy<sup>1</sup> · Ijaz Cheema<sup>1</sup> · Liza McLornan<sup>1</sup> · Niall Davis<sup>1,2</sup> · Mark Quinlan<sup>1,2</sup>

Received: 5 January 2021 / Accepted: 17 February 2021 / Published online: 25 February 2021  
© Royal Academy of Medicine in Ireland 2021

## Abstract

**Background** The COVID-19 pandemic has seen a change in the numbers of patients presenting to the emergency department (ED) with non-COVID symptoms, resulting in delayed presentations of many medical and surgical conditions.

**Aims** To examine the impact of COVID-19 on acute urolithiasis presentations to the ED.

**Methods** In this retrospective, single-centre, observational study, we reviewed all CT KUBs (and their corresponding cases) ordered in ED for possible acute urolithiasis in a 100-day period immediately prior to COVID-19 and in a 100-day period immediately afterwards. We sought to establish the number of CT KUBs performed and the number confirming urolithiasis. We recorded patients' age, gender, stone size and location. We also analysed CRP, WCC and creatinine as well as the duration of patients' pain and the management strategy adopted for each case.

**Results** One hundred ninety-eight CT KUBs were performed, 94 pre-COVID and 104 intra-COVID. A total of 70.2% ( $n=66$ ) and 66.3% ( $n=69$ ) were positive for urolithiasis pre-COVID and intra-COVID respectively ( $p=0.56$ ). There was a significantly higher percentage of females pre-COVID compared with intra-COVID (54% vs 36%,  $p=0.012$ ). There was no difference in median ureteric stone size seen between the groups (4.7 mm pre-COVID vs 4.0 mm intra-COVID,  $p=0.179$ ). There were no significant differences in WCC, CRP or creatinine levels. One patient in the pre-COVID group and two in the intra-COVID groups required percutaneous nephrostomies.

**Conclusion** The COVID-19 pandemic *did not* result in fewer or sicker patients presenting with acute ureteric colic cases to the ED.

**Keywords** Acute · Colic · COVID-19 · Emergency · Stone · Urolithiasis

## Introduction

Ureteric colic is a severe pain caused by the passage of stones through the urinary system, and it is one of the most common urological diseases requiring an Emergency Department (ED) visit [1, 2]. The reported prevalence of urinary stones varies from 10 to 12% in industrialised countries [3]. Classically, ureteric colic presents as acute, severe pain radiating from the flank to the groin which invariably mandates urgent presentation to ED. Delayed presentations can result in

urosepsis and acute kidney injury. Interestingly, urosepsis due to an untreated, obstructed, infected kidney or a stone matrix acting as a source for bacterial growth is even more common now than in the past [4].

Reports suggest that the numbers presenting to ED with common, acute pathologies dropped dramatically while the COVID-19 virus took hold across the world or that alternatively, patients were instead delaying presentation until at a more serious state of illness. One can speculate that during the acute pandemic period, people are perhaps postponing visiting the ED until their symptoms become intolerably severe when they would usually have presented sooner in non-COVID times.

In this study, we sought to examine the impact of COVID-19 on presentations to our ED with acute ureteric colic. In particular, we wanted to establish if COVID-19 had resulted in fewer stone presentations or sicker patients.

✉ Mark Quinlan  
lynagh@hotmail.com

<sup>1</sup> Dept of Urology, Connolly Hospital,  
Blanchardstown Dublin 15, Ireland

<sup>2</sup> Dept of Surgery, The Royal College of Surgeons in Ireland,  
Dublin, Ireland

## Patients and methods

### Overview and study design

This is an observational, retrospective and single-centre study. We reviewed all computerised tomography (CT) of kidneys, ureter and bladder (KUB), and their corresponding cases, ordered in the ED for a query of acute ureteric colic in a 100-day period immediately prior to the arrival of COVID-19 and in a 100-day period immediately since COVID-19's arrival. The date of COVID-19 arrival was taken as the day that our institution announced the immediate cessation of all elective surgical activity due to escalating fears over the COVID-19 pandemic (March 16, 2020). The number of scans performed was captured via a refined computer search of all CT KUBs on our hospital Radiology system. We then eliminated all elective/outpatient/non stone-related CT KUBs so that only those from the ED querying a possible acute stone were included in the study. In our institution, low-dose, non-contrast, cross-sectional abdominal imaging in the form of a CT KUB is the imaging modality of choice for all suspected ureteric colic cases except when contraindicated such as during pregnancy. We therefore did not include other imaging modalities, such as X-ray KUBs, renal ultrasound scans or scans labelled 'CT abdomen/pelvis' or 'CT urogram'. We sought to establish the overall number of CT KUBs performed in both time periods and the number that confirmed urolithiasis. The data we then extracted included patients' age, gender, stone size and stone location. We also included blood parameters such as CRP, WCC and creatinine. When documented on the radiology request form, the duration of patients' pain was also recorded. Finally, the management of each patient with a confirmed renal or ureteric stone was noted, namely whether they were treated expectantly/conservatively, admitted for immediate surgical/radiological care or given an urgent elective date for surgery.

**Table 1** Imaging and patient demographics. No statistically significant differences were noted in the number of scans performed between the groups, but there were statistically significantly fewer females and more males in the intra-COVID group

	Pre-COVID <i>n</i> (%)	Intra-COVID <i>n</i> (%)	Statistical signifi- cance
Total CT KUBs	94	104	$p=0.56$
Positive for urolithiasis	66 (70.2)	69 (66.3)	
Age, median (range)	42 (20–84)	42 (21–92)	$p=0.771$
Male	43 (45.7)	66 (63.5)	$p=0.012$
Female	51 (54.3)	38 (36.5)	

### Statistical analysis

Statistical analysis was performed using IBM SPSS software, version 20.0 (SPSS Inc., Chicago, IL). Distributions were summarised using frequencies, medians and ranges. The independent-samples *t* test and Pearson's chi-square test were used to assess the association between continuous and categorical variables respectively. A *p* value less than 0.05 was considered statistically significant.

## Results

### CT KUBs and patient demographics

A total of 198 acute CT KUBs were performed, 94 pre-COVID and 104 intra-COVID. Of these, 70.2% ( $n=66$ ) and 66.3% ( $n=69$ ) were positive for urolithiasis pre-COVID and intra-COVID respectively ( $p=0.56$ ) (Table 1).

There was a slight overall male predominance (male/female = 1.25:1) but a significantly higher percentage of female cases in the pre-COVID period compared with the intra-COVID period (54% vs 36%,  $p=0.012$ ). The median age at diagnosis was 42 in both groups (Table 1).

### Stone size and location

No differences in stone location were seen between the pre-COVID and intra-COVID groups (Table 2). The majority of stones were located in either the distal ureter (41.5%,  $n=56$ ) or the proximal ureter (31.1%,  $n=42$ ). At the time of imaging, 7.6% ( $n=5$ ) and 4.3% ( $n=3$ ) of stones had already passed into the urinary bladder in the pre-COVID and intra-COVID groups respectively, while one patient had a stone within their urethra in the pre-COVID period (Table 2).

The overall median stone size for all types of stones in both periods combined was 4.5 mm (range 1–52 mm) and 4.3 mm (range 1.5–13 mm) for just ureteric stones. There was no difference in median ureteric stone size seen between

**Table 2** Stone location. No statistically significant differences were noted in stone location between the groups

Stone Location	Pre-COVID <i>n</i> (%)	Intra-COVID <i>n</i> (%)	Statistical significance
Kidney	12 (18.2)	14 (20.3)	$p=0.58$
Proximal ureter	21 (31.8)	21 (30.4)	$p=0.86$
Mid ureter	1 (1.5)	1 (1.4)	$p=0.97$
Distal ureter	26 (39.4)	30 (43.5)	$p=0.63$
Bladder	5 (7.6)	3 (4.4)	$p=0.42$
Urethra	1 (1.5)	0 (0)	$p=0.30$

the pre-COVID and intra-COVID groups (4.7 mm vs 4.0 mm respectively,  $p=0.179$ ) (Table 2).

### Symptom duration and laboratory data

The duration of pain prior to presentation to the ED was established from the CT KUB request form although this data was only available in 25.4% of cases ( $n=34$ ). Of the patients with confirmed urolithiasis, the median duration of pain was 2 days (range 1–14 days) prior to the arrival of COVID-19 compared with 1 day (range 1–7 days) during the COVID period ( $p=0.104$ ).

Similarly, there were no significant differences in patients' WCC ( $9.9 \times 10^9/L$  vs  $10.8 \times 10^9/L$ ,  $p=0.943$ ), CRP (3.5 mg/L vs 2.3 mg/L,  $p=0.117$ ) or serum creatinine levels (83  $\mu\text{mol/L}$  vs 89  $\mu\text{mol/L}$ ,  $p=0.587$ ) between the pre-COVID and intra-COVID groups respectively.

### Treatment strategy and outcomes

When comparing the initial treatment strategy chosen for stone patients between the different study time periods, no significant differences ( $p=0.862$ ) were seen in the numbers initially considered suitable for conservative management (68.2%,  $n=45$  pre-COVID vs 69.6%,  $n=48$  intra-COVID) or in those deemed to require surgical or radiological intervention (31.8%,  $n=21$  pre-COVID vs 30.4%,  $n=21$  intra-COVID).

In the pre-COVID period, all of the patients who were felt to require surgical or radiological intervention following initial assessment by the urology team were either admitted directly to our institution or, if presenting out of hours, transferred to a neighbouring sister hospital for admission. In the intra-COVID period, the same scenario remained. Additionally, in the intra-COVID period, four patients were offered a prompt elective slot on an upcoming theatre list in an outsourced hospital (see discussion) with a median time to definitive intervention of 5 days (range 2–13 days).

The majority of patients requiring intervention received primary surgical treatment while one patient in the pre-COVID group and two patients in the intra-COVID group required percutaneous nephrostomy insertion by interventional radiology as they presented with sepsis secondary to obstructing stones ( $p=0.621$ ). There was no difference ( $p=0.054$ ) in median time to intervention between the pre-COVID (median 2 days, range 0–5 days) and intra-COVID groups (median 2 days, range 0–37 days). The patient who waited 37 days before intervention had tested positive for COVID-19 at the time of presentation to ED with flank but remained clinically well. After discussion with our anaesthetic colleagues, her surgical intervention was deferred and carried out semi-electively following a 3-week period of self-isolation and a negative swab.

## Discussion

The COVID-19 pandemic has led to significant amounts of fear and anxiety amongst people about contracting the virus. This is especially true when it comes to concerns about becoming infected with the virus in hospitals. Reports suggest that the volume of patients presenting to ED with typical and common complaints fell markedly as the virus swept across the globe. Other reports indicate that some patients were postponing their ED attendance until they had reached a more serious state of illness with intolerably severe symptoms. Romero et al. report that during the acute COVID-19 pandemic period, fewer patients presented with acute appendicitis to the ED in their institution and those who did presented at a more severe stage of the disease [5]. Schirmer et al. have published data supporting an association between public awareness and limitations imposed on public life during the COVID-19 pandemic in the USA and a delay in presentation for acute ischemic stroke patients to a stroke centre [6]. Specific to Urology, a Portuguese study showed nearly 50% fewer patients visiting their urological ED during the pandemic compared with the same period 1 year earlier [7]. Of note, the percentage of cases requiring emergency hospitalisation in their study showed a higher percentage during the pandemic suggesting that patients were indeed presenting later and more unwell. These findings are corroborated in other similar studies—an Italian study showed a reduction of > 50% in urgent urological consultations via ED during the crisis but with a higher risk of admission [8].

Specific to urolithiasis, the numbers presenting in the aforementioned Portuguese paper with ureteric colic fell from 59 over a 3-week period in 2019 to 19 over the same weeks in 2020 [7]. Conversely, another study over a 6-week period showed the number of first aid accesses for urinary stone emergencies did not significantly change during COVID-19, but patients presenting during COVID-19 time showed significantly higher serum levels of creatinine when compared with a pre-pandemic period, again suggesting a possible delay in terms of patient presentation to the hospital, potentially related to the fear arising from the pandemic [9]. However, no significant differences were detected in terms of complication rates or urinary stone diameter.

Other studies have shown a reduction in general urological and specifically urolithiasis presentations during COVID-19 [7, 8, 10, 11]. We did not find the same results. Interestingly, the periods studied in those papers ranged in duration from just 1 week to 6 weeks. Our study encompassed a 100-day period. We deliberately picked a 100-day time period as we believed the time period in those other studies may not have been long enough to fully appreciate the effects of COVID-19. Furthermore, by using a long timeframe like 100 days, it enabled us to see if any early reluctance to present to ED

during COVID-19 subsided in later weeks as patients' fears eased. It is plausible that those other studies may have seen a reduction in activity in the early days of COVID when fear and anxiety levels were at their highest, but with longer follow up and a relaxation of patients' concerns, their results could have looked very different. This is certainly true in our study where in the first 50 days post-COVID, only 42 CT KUBs were performed—this number rose to 62 in the next 50 days ( $p=0.085$ ). We also deliberately chose to compare the COVID-19 period to a time period immediately prior to COVID-19 rather than a time period last year as has been done in most other studies, as we felt this would more clearly illustrate any sudden or abrupt change in patients' behaviour brought about by the pandemic as the global situation rapidly deteriorated.

In their similar study, Flammia et al. showed no significant differences in terms of complication rates or urinary stone diameter [9]. Our findings concur with that. Without reviewing each set of medical notes, it is difficult to be absolutely certain about how unwell a patient was upon presentation, but we believe that looking at blood parameters such as WCC, CRP and creatinine, as well as reviewing the numbers who needed urgent nephrostomy insertion, gives a very good surrogate indicator of the clinical status of patients. In our study, COVID-19 did not appear to give rise to sicker stone patients.

Experts have suggested that patients with ureteric colic should be managed conservatively as much as possible during COVID-19 [12]. In reality, studies have shown that the proportion of patients with colic who received immediate JJ stent placement or endoscopic lithotripsy was actually higher in 2020 versus the same time period in 2019, likely to prevent patients from repeated presentations to the hospital which could have ultimately increased the risk of COVID-19 infection [10]. However, we did not find any significant difference in the way we managed our patients during the two time periods studied with the exception of introducing some urgent elective admissions during COVID-19 for confirmed ED stone patients. This finding was borne out of the unusual situation in which the country found itself. Prior to the pandemic, our departmental policy was to immediately admit anybody with a confirmed stone who we thought needed intervention, e.g. for ureteroscopy or stent etc. However, during COVID-19, our government took over all our private hospitals for 3 months in preparation for the worst-case scenario. Thankfully, this never quite arose, and so the private hospitals had unfilled capacity which was available for public patients. We could then guarantee patients an elective bed for their procedure on an urgent basis when they went home from ED.

Our study has limitations. Firstly, our numbers are relatively small and come from a single centre. Of course, it is possible that the results may be different with larger data from multiple centres. Secondly, the study is retrospective

in nature with inherent limitations therein. Thirdly, we only included studies booked as CT KUBs. Other CT scans such as 'CT abdomen/pelvis' or 'CT urogram' were not included, and thus, we may have missed some stone cases. It would not have been possible to review all types of imaging of the abdomen/pelvis by CT as the numbers were too vast. Furthermore, it is departmental policy within our institution that all suspected cases of ureteric colic receive a CT KUB (the gold standard modality for diagnosis urolithiasis), unless contraindicated, and no patients are managed based on a clinical diagnosis alone [13]. This practice did not change during the COVID period; thus, the numbers of stones possibly missed by our search strategy should be low. Next, our first time period included the Christmas and New Year period, a time of year that can be quiet in EDs, and so, that period may not truly represent what happens during the rest of the year [14]. We would contest that as with our findings during the COVID-19 period, that when patients have acute colic, the pain is typically so intense and so insufferable that patients will still attend ED. We certainly found CT KUBs performed on Christmas day in our study indicating that patients with severe pain/colic tend to present regardless of anything else happening in their lives.

Finally, it is possible that our results are confounded by the seasonal variation of stone presentations. Some authors of similar studies chose to compare stone rates from the same time period a year prior to COVID-19, as opposed to the time period immediately prior to the outbreak as we have done, in an attempt to mitigate this potential confounder [8, 9]. However, the seasonal variation of stone presentations is thought to be related to differences in ambient temperatures, humidity and other meteorological factors, none of which remain consistent on a yearly basis [15]. There are very good data suggesting that a higher ambient temperature has an association with kidney stone disease, and temperatures were certainly unusually high in the early weeks of COVID-19 in Ireland [16]. However, those temperatures were not sustained and despite being a deviation from the norm, we do not believe that temperatures in Ireland ever get consistently high enough to pose a genuine threat for stone formation. As such, the authors feel that comparing the time period immediately prior to and following the COVID-19 outbreak is an acceptable method for investigating the impact of the pandemic on acute ureteric colic presentations.

## Conclusion

In conclusion, to the best of our knowledge, this is the largest study and with the longest time period looking specifically at CT-proven, emergency ureteric colic presentations during COVID-19. The COVID-19 pandemic and its accompanying

anxiety and fears did not impact on the frequency of acute ureteric colic presentation to our ED. Based on stone size, renal function, blood results and the management strategy for patients with confirmed stones, there was no apparent delay in presentation and no apparent increased severity of the caseload. The authors hypothesise that the pain associated with ureteric colic is so extreme that it mandates attendance at ED regardless of the prevailing national or global situation.

**Author contribution** S Anderson: protocol development, data collection, data analysis, manuscript writing. D McNicholas: data collection. C Murphy: data collection. I Cheema: manuscript editing. L McLornan: manuscript editing. NF Davis: manuscript writing. MR Quinlan: protocol development, data collection, data analysis, manuscript writing.

**Code availability** Statistical code available.

## Declarations

**Ethics approval** Approval was obtained from the ethics committee of our hospital. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

**Availability of data and material** Readily available for review if required.

**Conflict of interest** The authors declare that they have no conflicts of interest.

## References

- Carter MR, Green BR (2011) Renal calculi: emergency department diagnosis and treatment. *Emerg Med Pract.* 13(7):1–17 quiz 8
- Chang HY, Daubresse M, Kruszewski SP, Alexander GC (2014) Prevalence and treatment of pain in EDs in the United States, 2000 to 2010. *Am J Emerg Med* 32(5):421–431
- Golzari SE, Soleimanpour H, Rahmani F, Zamani Mehr N, Safari S, Heshmat Y et al (2014) Therapeutic approaches for renal colic in the emergency department: a review article. *Anesth Pain Med* 4(1):e16222
- Fukushima H, Kobayashi M, Kawano K, Morimoto S (2018) Performance of quick sequential (sepsis related) and sequential (sepsis related) organ failure assessment to predict mortality in patients with acute pyelonephritis associated with upper urinary tract calculi. *J Urol* 199(6):1526–1533
- Romero et al (2020) Acute appendicitis during coronavirus disease 2019 (COVID-19): changes in clinical presentation and CT findings. *J Am Coll Radio: JACR* 17(8):1011–1013
- Schirmer CM, Ringer AJ, Arthur AS, Binning MJ, Fox WC, James RF et al (2020) Delayed presentation of acute ischemic strokes during the COVID-19 crisis. *J Neurointerv Surg* 12(7):639–642
- Madanelo M, Ferreira C, Nunes-Carneiro D, Pinto A, Rocha MA, Correia J et al (2020) The impact of the coronavirus disease 2019 pandemic on the utilisation of emergency urological services. *BJU Int* 126(2):256–258
- Motterle G, Morlacco A, Iafrate M, Bianco M, Federa G, Xhafka O, et al (2020) The impact of COVID-19 pandemic on urological emergencies: a single-center experience. *World J Urol.* 1–5
- Flammia S, Saliciccia S, Tufano A, Busetto GM, Ricciuti GP, Sciarra A (2020) How urinary stone emergencies changed in the time of COVID-19? *Urolithiasis* 48(5):467–469
- Novara G, Bartoletti R, Crestani A, De Nunzio C, Durante J, Gregori A et al (2020) Impact of the COVID-19 pandemic on urological practice in emergency departments in Italy. *BJU International* 126(2):245–247
- Porreca A, Colicchia M, D'Agostino D, Amenta M, Corsaro A, Zaramella S et al (2020) Urology in the time of coronavirus: reduced access to urgent and emergent urological care during the coronavirus disease 2019 outbreak in Italy. *Urol Int* 104(7–8):631–636
- Proietti et al. (2020) Endourological stone management in the era of the COVID-19. *Eur Urol* 78(2):131–133
- Drake T, Jain N, Bryant T, Wilson I, Somani BK (2014) Should low-dose computed tomography kidneys, ureter and bladder be the new investigation of choice in suspected renal colic?: a systematic review. *Indian J Urol: IJU: J Urol Soc India* 30(2):137–143
- Krinsky-Diener M, Agoritsas K, Chao JH, Sinert R (2017) Predicting flow in the pediatric emergency department: are holidays lighter? *Pediatr Emerg Care* 33(5):339–343
- Boscolo-Berto R, Dal Moro F, Abate A, Arandjelovic G, Tosato F, Bassi P (2008) Do weather conditions influence the onset of renal colic? A novel approach to analysis. *Urol Int* 80(1):19–25
- Geraghty RM, Proietti S, Traxer O, Archer M, Somani BK (2017) Worldwide impact of warmer seasons on the incidence of renal colic and kidney stone disease: evidence from a systematic review of literature. *J Endourol* 31(8):729–735

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.