



Consensus of multiple national guidelines: agreed strategies for initial stone management during COVID-19

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Abstract

Purpose To review the existing available information regarding urolithiasis management and the impact of COVID-19 on this, and propose recommendations for management of emergency urolithiasis presentations in the COVID-19 era.

Methods Review of published guidelines produced by Urological Governing Bodies, followed by the literature review regarding urolithiasis management during the COVID-19 pandemic.

Results Consistent recommendations across guidelines and literature were that urolithiasis with concurrent sepsis or renal failure remains a urological emergency warranting urgent intervention within the pandemic environment. Ureteric stenting and percutaneous nephrostomy are considered equivalent for decompression in this setting, with both ideally to be performed under local anaesthesia where possible to spare ventilators and reduce aerosol-generating procedures. Greater utilization of medical expulsive therapy and dissolution chemolysis may occur during the pandemic, and longer indwelling stent times may be accepted while definite stone clearance is deferred.

Conclusions Urolithiasis will continue to be a source of emergency presentations requiring urgent intervention during the COVID-19 pandemic. However, it is possible to limit these interventions to decompression of the collecting system in the setting of concurrent obstruction or infection, performed under local anaesthesia to limit use of resources and minimise aerosol-generating procedures, with deferral of definitive management.

Keywords COVID-19 · Coronavirus · Pandemic · Urolithiasis · Urology

Introduction

The COVID-19 global pandemic is potentially the most significant challenge faced by healthcare services in the lifetime of today's clinicians, and impacts all specialties. Outside of the direct threat to patients and staff from infection with the virus itself, ramifications of bed and equipment shortages (such as Intensive Care Unit (ICU), ventilator and Personal Protective Equipment (PPE) availability) and delays in diagnosis and management of non-COVID conditions will add

additional complexity to management of the situation, and it is likely that alterations to the best practice recommendations will need to be accepted in the short term.

Urolithiasis, and in particular renal colic, is a common emergency urological presentation. Timely management is required to control pain and prevent renal failure secondary to obstruction, and is critical where concurrent urosepsis is present. It is unlikely that the burden of this work will reduce over the duration of the COVID-19 pandemic. Consequently, Urologists must have a plan of action on how best to manage these patients within the limitations of the pandemic environment. While there are multiple established efficacious treatments for urolithiasis, frequently these require anaesthetic, operative and or intensive care support in the perioperative period as well as an inpatient hospital stay. Availability of all these resources may be limited or even unavailable in the pandemic setting. Therefore, decision making regarding most appropriate treatment must consider not only individual patient presentation but also judicious use of these resources.

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Our objective was to review the existing available information regarding urolithiasis management and the impact of COVID-19 on this, and propose recommendations for the initial management of emergency urolithiasis presentations in the COVID-19 era.

Materials and methods

We first accessed the webpages of major urological governing bodies and clinical guideline institutions including the American Urological Association (AUA), British Association of Urological Surgeons (BAUS), Canadian Urological Association (CUA), European Urological Association (EAU), Urological Society of Australia and New Zealand (USANZ), Societe Internationale d'Urologie (SIU) and National Institute for Health and Care Excellence (NICE), reviewing these for guidelines or position statements directly relevant to Urolithiasis or management of urolithiasis during COVID-19.

We then conducted a non-systematic literature review searching PubMed database with the search terms Urology AND covid-19.

Having summarised the existing information gathered from these sources, we discuss basic principles of working within a global pandemic proposing interim recommendations for emergency management of urolithiasis during the pandemic.

Results: existing information

Guidelines and position statements: stone management

Guidelines for urolithiasis management were available from the American Urological Association (AUA), British Association of Urological Surgeons (BAUS), Canadian Urological Association (CUA), European association of Urology (EAU) and NICE [1–6]. Their recommendations are summarised in the table (Table 1). There was concordance between guidelines on fundamental concepts including that concurrent obstructing stone and UTI/urosepsis constitutes a urological emergency and should be managed by urgent decompression with either ureteric stenting or nephrostomy (which were considered of equivalent efficacy), that non-contrast CT is the standard for diagnostic stone imaging, and that NSAIDs should be the first-line analgesic choice for patients with stones. Recommendations regarding the role of conservative management, medical expulsive therapy and stenting were more varied. Notably we were not able to locate published guidelines directly produced by SIU or USANZ.

Guidelines and position statements: COVID-19

Advice from urological governing bodies regarding urological practice during the COVID-19 pandemic was variable in both quantity and form. The most formal written recommendations from a urological body were produced by the EAU in the document 'EAU Guidelines office rapid reaction group: An organisation-wide collaborative effort to adapt the EAU guidelines recommendations to the COVID-19 era' [7]. In addition, the EAU also provided a link to a collation of all currently published or accepted articles in its partner journal '*European Oncology*'. USANZ also published of a total of four sets of specific guidelines [8–11].

Similar to the EAU, CUA published their own written COVID-19 recommendations, as well as providing links to relevant articles published in the Canadian Urological Association Journal (CUAJ) [12]. In addition, a 'Urology Support Webseries' was publicly available from the 'CUA COVID-19 Educational Resources' page of the CUA website, with the recording 'An update from the Canadian Endourology Group (CEG) during the COVID-19 crisis' specifically discussing approaches to stone patients [13, 14]. These recommendations are summarised by Table 2.

In contrast to the other organisations, the SIU website included only a general statement on COVID-19 without specific guidelines available, and information on the BAUS site was available only to members, requiring a login for access. Finally, the AUA site referenced the recommendations made by other health and government bodies and provided links to relevant articles published in *The Journal of Urology*, but did not appear to have separately produced any AUA specific guidelines regarding Urological practice during the COVID-19 era in addition to these.

Current literature

Non-systematic literature review was conducted with most recent review of results on 6/6/2020. Search of PubMed using the terms Urology AND COVID-19 (all fields) returned 243 results. 141 of these were relevant to Urological practice during COVID-19 with 16 reporting findings or making recommendations specific to urolithiasis management [7, 15–29]. Recommendations and findings relevant to urolithiasis in the included articles are summarised in the table (Table 3). With the exception of a single systematic review, included papers were of moderate to low level of evidence including observational studies (2), narrative reviews or publication of expert opinion/recommendations (12) and a case report (1). The included systematic review concerned general urologic manifestations

Table 1 Urolithiasis guidelines and position statements—general

	AUA	BAUS	CUA	EAU	NICE
Analgesia	Not specified	NSAIDs should be given for analgesia immediately after initial assessment providing no contraindications	Not specified	NSAIDs PO or PR first line Opioids second line	NSAID by any route is first-line treatment Intravenous paracetamol if NSAID is contraindicated or not giving sufficient pain relief Consider opioids if both NSAID and paracetamol contraindicated or providing insufficient pain relief Do not offer antispasmodics
Imaging/investigations	Non-contrast CT should be performed to determine best modality of treatment Functional imaging DTPA/MAG3 may be performed if clinically significant loss of function suspected Reimage if passage of stones suspected or stone movement will change management	All patients should have urine dipstick + – culture, creatinine and electrolytes, calcium, urate, CBC and CRP Clotting studies should be performed if percutaneous intervention is planned Blood cultures if febrile > 38 or has signs of SIRS Non-contrast CT is the standard for diagnosis of acute ureteric colic	US in pregnant patients first line	Non-contrast CT is standard In pregnancy US first line, MRI second line Suggest all patients undergo urine dip/micro/culture plus blood creatinine/uric acid/calcium/sodium/potassium and CRP Coagulation studies if intervention likely/planned	Non-contrast CT within 24 h of presentation for adults with suspected colic If pregnant or paediatric patient offer US instead of CT
Observation/conservative management	Uncomplicated stone < 10 mm should be offered observation Intervention should be offered if unsuccessful after 4–6 weeks or patient/clinician shared decision making to intervene earlier	Observation is reasonable in patients without evidence of sepsis and with normal renal function, unilateral stones, normal contralateral renal unit and well controlled pain Review of patients undergoing observation should be undertaken at a maximum of 4 weeks	Appropriate for < 5 mm distal ureteric stones providing no evidence of infection or threat to renal function	Can offer observation/conservative management for small distal ureteric stones, suggest 6 mm or less as cutoff for small Asymptomatic renal stones require periodic follow-up imaging initially 6 monthly and stone growth is an indication for intervention	Consider watchful waiting if stone is < 5 mm or larger than 5 mm AND person/family decide on this following informed discussion of risks and consequences

Table 1 (continued)

	AUA	BAUS	CUA	EAU	NICE
Medical expulsive therapy (MET)	Distal ureteric stone < 10 mm should be offered MET with alpha-blockers	Patients should not be routinely commenced on MET as efficacy remains controversial If used patients should be counselled that use of alpha-blockers is off label	Consider offering to distal ureteric stones < 5 mm in size Improves stone passage following SWL	Controversy continues, however, can reduce frequency of colic episodes Increase stone expulsion rate in steinstrasse after SWL Appears to be efficacious in treatment of patients with ureteric stones amenable to conservative management (especially distal ureteric stones > 5 mm)	Consider alpha-blockers for adults, children and young people with distal ureteric stones < 10 mm
Surgical intervention modalities	URS is first-line therapy for mid/distal ureteric stones requiring intervention Non-lower pole renal stone < 20 mm may offer SWL or URS, < 10 mm SWL/URS is first line Total stone burden > 20 mm PCNL should be offered as first line and SWL should NOT be offered as first line (staged URS an alternative if not a candidate for PCNL)	Primary treatment of the stone should be the goal and may be with SWL or URS Intervention should be undertaken within 48 h of the decision to intervene	Both SWL and URS are safe and efficacious for ureteral stones URS more appropriate than SWL in ureteric stones > 10 mm Offer URS if × 2 failed SWL	Offer intervention if increasing size of stone, obstruction, associated infection or pain acute/chronic PCNL first line for > 2 cm renal stone 10–20 mm renal stone SWL or URS first line < 10 SWL All ureteral stone SWL or URS	Renal or ureteric stone < 10 mm: SWL or URS (consider PCNL if these fail or are not an option) Renal or ureteric stone 10–20 mm: URS or SWL (consider PCNL if these fail or are not an option) Renal stone > 20 mm: PCNL, consider URS if PCNL not an option
Sepsis/obstruction	Patient with obstructing stone and suspected infection must be urgently drained with stent OR nephrostomy, and delay stone treatment If purulent urine is encountered, clinician should abort stone removal procedure and establish drainage (stent/nephrostomy)	Patient with sepsis and obstructing stone should have urgent decompression with a stent or nephrostomy tube. This should be performed within 12 h under broad spectrum antibiotic cover Definite stone treatment should be delayed until sepsis has resolved	Emergent drainage with stent or nephrostomy Stent and nephrostomy have equivalent outcomes Delay definite stone treatment until decompression and appropriate antibiotics to treat infection	Urgent decompression with stent or nephrostomy Stent of nephrostomy equivalent efficacy	Not specified

Table 1 (continued)

	AUA	BAUS	CUA	EAU	NICE
Timing: follow-up and interventions	Intervene if conservative/MET unsuccessful in 4–6/52 Nil other specified	CT should be performed with 14 h of admission for the standard (non-pregnant patient) Follow-up URS should be performed with 4 weeks of stenting Decompression should be performed with 12 h in setting of sepsis Review of patients under observation at maximum of 4 weeks Stents should be removed within 2 weeks of decision to remove them	Not quantitatively specified	Not quantitatively specified	Offer surgical intervention within 48 h of diagnosis or readmission if pain is ongoing and not tolerated OR stone is unlikely to pass
Stenting	May omit stenting post-URS providing no ureteric injury or other anatomic abnormality, normal contralateral kidney, no renal function impairment, second URS not planned Placement of stent prior to URS should not be performed routinely Alpha-blockers and anti-muscarinics may be offered to reduce stent discomfort Routine stenting should not be performed in patients undergoing SWL	Stent may be inserted where primary treatment of the stone is not feasible SWL should not be undertaken with a stent in situ When a decision to remove a stent is made, the removal should be undertaken within a maximum of 2 weeks of this decision	Stenting does not reduce incidence steinstrasse post-SWL Stent should be left following use of an access sheath for URS Pre-stenting may improve success rates for stones > 10 mm	Routine stenting prior to URS no necessary, however, may improve outcome Do not stent pre-SWL	Do not offer pre-SWL stenting unless SWL is for staghorn stone Do not routinely offer stenting to patients undergoing URS for stones under 20 mm
Management and follow-up timing of stents	Not quantitatively specified	Ureterscopy should be undertaken within 4 weeks of stenting to minimise patient morbidity	Not quantitatively specified	Not quantitatively specified	Not quantitatively specified
Pre-operative urine management	Required to obtain urinalysis prior to intervention, including culture if evidence of infection Antimicrobial prophylaxis should be administered prior to stone intervention	Broad spectrum antibiotic cover for patients undergoing decompression in setting of sepsis	Nil specified outside treatment of sepsis prior to definitive stone treatment	Urine should be collected and antibiotics commenced immediately post-decompression Urine microscopy should be done and any UTI treated prior to any stone removal procedure	Not specified

Table 1 (continued)

	AUA	BAUS	CUA	EAU	NICE
Prevention and metabolic factors	<p>Stone material should be sent for analysis</p> <p>Workup may include; PTH if primary hyperparathyroidism suspected, 24 h urine collection and analysis in high risk, recurrent stone formers</p> <p>Recommend a fluid intake that will result in a urine volume of at least 2.5 L/day</p> <p>Dietary recommendations based on stone composition</p> <p>Pharmacologic therapies may include thiazide diuretics, potassium citrate, allopurinol, cysteine binding drugs dependent on stone composition</p>	Not specified	<p>All patients should undergo a limited metabolic evaluation including urinalysis and culture, serum electrolytes, serum calcium and serum creatinine + 24 h urine collection and analysis in any patient willing to undergo this and modify their lifestyle</p> <p>Effort should be made to collect stones and submit for analysis</p> <p>Recommend fluid intake of 2.5–3 L/day or to achieve urine output of 2.5 L/day</p> <p>Dietary calcium intake should be 1000–1200 mg/day</p> <p>Vitamin D repletion is appropriate in those with a deficiency and calcium oxalate stones</p> <p>Recommend moderation of animal protein intake and avoidance of purine rich foods</p> <p>Sodium intake should be between 1500 and 2300 mg daily</p> <p>Use of thiazide diuretics, alkali citrate, allopurinol dependent on stone composition</p>	<p>Stone analysis should be performed in all first time stone formers</p> <p>Repeat stone analysis if recurrence despite pharmacological intervention, early recurrence, late recurrence after a prolonged stone free period</p> <p>×2.24 h urine collection</p> <p>Recommend 2.5–3 L fluid intake/day OR target to 2–2.5 L urine output</p> <p>Calcium 1–1.2 g/day</p> <p>NaCl 4–5 g/day</p> <p>Pharmacological treatments dependent on stone composition</p>	<p>Adults should drink 2.5–3 L water per day</p> <p>Consider serum analysis</p> <p>Measure serum calcium</p> <p>Consider referring children or young people to nephrologist with expertise in assessment and metabolic investigations</p> <p>Avoid carbonated drinks</p> <p>Limit daily salt intake to <6 g</p> <p>Daily calcium intake should be 700–1200 mg/day</p> <p>Use of potassium citrate, thiazide diuretics based on stone composition</p>

CT computed tomography, DTPA diethylenetriamine pentaacetic acid, h hours, L litres, MAG3 Mercurio-acetyl triglycine, MET medical expulsive therapy, PCNL percutaneous nephrolithotripsy, PTH parathyroid hormone, SIRS systemic inflammatory response syndrome, SWL shock wave lithotripsy, US ultrasound, URS ureteroscopy

Table 2 Summary of COVID-19-specific guidelines/consensus statements produced by Urological bodies

Urological body	Publication	Recommendations relevant to stone management
EAU	EAU Guidelines office rapid reaction group: an organisation-wide collaborative effort to adapt the EAU guidelines recommendations to the COVID-19 era [7]	<p>Image suspected stone patients with US followed by non-contrast CT</p> <p>Urgent decompression with either ureteric stent or nephrostomy indicated in urolithiasis with concurrent sepsis, anuria, renal insufficiency, uncontrolled pain</p> <p>In the short term, preferentially use ureteric stents on string to facilitate self-removal. Otherwise stent removal as soon as situation allows, with prioritization of those patients experiencing pain/other symptoms from JJ stent</p> <p>Medical Expulsive Therapy and Chemolysis are of greater importance during pandemic to avoid surgical intervention where possible</p> <p>Perform stone analysis in first time stone formers, postpone complete metabolic workup</p> <p>Recommended PPE including double gloves, gown, face shield, virus proof mask</p> <p>Endourological conditions which may warrant urgent surgical intervention include: Symptomatic stones, obstructed +—infected kidneys, stents in situ</p> <p>Consultations should be managed using telehealth where possible</p> <p>Recommended operating theatre PPE: gown, gloves, apron, surgical cap and mask, eye protection (low-risk asymptomatic cases) PLUS full-face protection level 3 mask or ventilated hood in high-risk cases</p>
USANZ	<p>Guidelines: Urological prioritization during COVID-19 [8]</p> <p>Guidelines: Personal protection equipment (PPE) for urologists during COVID-19 Pandemic [9]</p> <p>Guidelines: Urological Unit Configuration and Case Selection During COVID-19 Pandemic [10]</p> <p>Guidelines: Case Deferral, Laparoscopy and Virtual Meetings During COVID-19 Pandemic [11]</p>	
CUA	<p>Choosing Wisely: COVID-19 Recommendations [12]</p> <p>Canadian Urological Association. CUA COVID-19 Educational Resources [13]</p> <p>Canadian Urological Association. An updated from the Canadian Endourology Group (CEG) during the COVID-19 Crisis [14]</p>	<p>Do not offer non-essential services to patients in person if virtual tools are available</p> <p>Delay non-essential care when possible</p> <p>Urgent intervention (decompression) still warranted in obstructing stone with infection/intractable symptoms/renal failure/failed MET, or bilateral stones/stone in single kidney</p> <p>Stone situations that continue to require urgent intervention with decompression include</p> <p>Sepsis</p> <p>Renal failure</p> <p>Single kidney or bilateral obstructing stones</p> <p>Ongoing symptoms/pain</p>
Common recommendations	n/a	

Table 3 Summary of literature relevant to urolithiasis management during COVID-19

Paper	Publication date	Level of evidence	Recommendations or findings on urolithiasis in COVID-19
Ficarra et al. [15]	23/3/2020	Expert OPINION	Treat infected/obstructed with stent or nephrostomy Consider ureteral stenting under local anaesthesia if possible
Simonato et al. [16]	30/3/2020	Expert opinion/narrative review	Imaging only to be performed in renal colic refractory to medical treatment Management with percutaneous nephrostomy or ureteric stenting, perform under local anaesthesia where possible
Goldman et al. [17]	3/4/2020	Expert opinion	Procedures for infected and obstructed stones (Tier 0 – threat to life if not performed) and ureteral stones (Tier 1 – threat of permanent dysfunction to extremity or organ) to continue as scheduled
Katz et al. [18]	3/4/2020	Expert opinion	Consider performing flexible cystoscopy and ureteric stent removal without delay to minimise risks of encrustation/UTIs/retained or forgotten stent
Puliatti et al. [19]	6/4/2020	Narrative review	Consider placing ureteral stents or nephrostomy under local anaesthesia if possible
Carneiro et al. [20]	9/4/2020	Narrative review	All procedures for urolithiasis should be suspended except for emergencies (infected obstructed, obstructed solitary kidney, bilateral obstruction, acute renal failure, refractory pain) For infected obstructed stone preferable opt for ureteric stent insertion under spinal anaesthesia, with bedside US guided percutaneous nephrostomy an alternative Perform primary ureterolithotripsy where safe and possible, utilising a stent with externalised strings to facilitate outpatient removal Patients with pre-existing ureteric stent in situ should remain with stent in situ for as long as possible
Ho et al. [21]	14/4/2020	Narrative review	Ureteric stent or nephrostomy insertion for infected obstructed stones remains an emergency, non-deferrable procedure Perform stenting/nephrostomy under local anaesthesia wherever possible Consider increased use of stents on strings to avoid additional hospital/procedure attendances wherever possible References an additional article (Ling et al.) which documents identification of COVID-19 in urine
Stensland et al. [22]	14/04/2020	Expert opinion/narrative review	Consider intervention for obstruction/infection – ureteral stent or nephrostomy, consider performing under LA, however if not possible this is considered an emergent procedure requiring intervention Most existing stents may undergo simple stent removal with even up to 6–12 months in situ, endoscopic management of stents is possible in most patients up to 30 months of indwelling time
Proietti et al. [23]	19/4/2020	Expert opinion	Patients with renal colic should be managed as conservatively as possible In the case of an obstructed infected kidney, only decompression of the system is recommended, either by stenting or nephrostomy Ureteric stenting is preferable to nephrostomy due to risk of inadvertent removal of nephrostomy and likely long delay to subsequent lithotripsy Where possible place ureteric stent or nephrostomy under local anaesthesia to spare a ventilator Pre-existing indwelling ureteric stents may be left 6–12 months, however, stent indwelling time should be considered in the prioritization process. Consider ‘pulse antibiotics’ in patients with an indwelling stent to reduce risk of urosepsis and requirement of a ventilator
Metzler et al. [24]	21/04/2020	Expert opinion/commentary	Treat only high priority and emergency cases surgically A mobile c-arm fluoroscopic x-ray system should be available in any dedicated COVID OR

Table 3 (continued)

Paper	Publication date	Level of evidence	Recommendations or findings on urolithiasis in COVID-19
Pang et al. [25]	24/4/2020	Case report	Includes a case report of asymptomatic COVID-19 in a patient presenting with ureteric calculus
Ribal et al. [7]	8/5/2020	Expert opinion and recommendations	Sepsis and renal failure remain indications for urgent intervention to decompress with ureteric stenting or nephrostomy Greater utilization of medical expulsive therapy and chemolysis may be appropriate Remove indwelling ureteric stents as soon as the situation allows
Novara et al. [26]	14/05/2020	Observational cross sectional study	Identified decrease in total emergency urological presentations, but increase in immediate JJ stent placement or lithotripsy, attributed to the need to resolve pain or sepsis and reduce likelihood of further presentations
Hughes et al. [27]	20/05/2020	Narrative review	Prioritise intervention in stone cases where there is concurrent sepsis. Renal failure or stent in situ (justification for intervening for those with stents in situ being that encrustation observed in 76.3% of cases left in situ > 12 weeks) Use alternatives to ureteroscopy/PCNL such as ESWL wherever possible Use stents on strings where possible; 10% risk of premature dislodgement, however, this is not shown to be associated with adverse outcome
Porreca et al. [28]	20/5/2020	Observational study	Observed a reduction in emergency urological presentations including urolithiasis patients (renal colic presentations) during COVID-19 compared to a pre-COVID reference week
Chan VW et al. [29]	27/05/2020	Systematic Review of Urological Manifestations of COVID-19	Identified one study where COVID-19 was detected in Urine (Peng et al.)

of COVID-19 rather than specifically reviewing stone disease during COVID-19. As in the guidelines, the literature findings were consistent that urolithiasis with concurrent urosepsis or renal failure is a urological emergency and so continues to warrant urgent intervention within the pandemic environment. Recommendations were also consistent that either ureteric stenting or nephrostomy is an appropriate management strategy for the infected obstructed stone during COVID-19; however, where possible these should be performed under local anaesthesia to reduce use on general anaesthesia and ventilators. No other recommendation was consistent across all papers.

Discussion

Safety of healthcare workers

Protecting healthcare workers from infection is of first priority during a pandemic, not only to minimise the risk of the disease and its sequelae to that individual, but also to prevent further transmission within the healthcare environment and external community, and to enable the maximum number of people to continue providing care in a strained healthcare system.

Given there is currently no known vaccination and limited effective treatments outside of supportive care, the

only existing strategy for prevention of infection for workers in the healthcare environment is through the use of adequate PPE. To date, COVID-19 has been identified to be present and potentially transmissible in bodily fluids including respiratory secretions, faeces, blood and urine as well as direct contact with surfaces, with some studies finding the virus to survive on inanimate surfaces for up to 72 h ** [30–33]. Thus, at a minimum, PPE for working directly with potential COVID-19-positive patients should include gown, gloves, eye protection and mask, ideally a N95 mask. Where there is a shortage of N95 or equivalent masks, these should be reserved for use during potentially aerosol-generating procedures. Some guidelines suggest powered air-purifying respirators, although it seems unlikely there are sufficient supplies of these to recommend, they are utilised by all the clinicians [33].

For urologist, the risk of contracting COVID-19 from exposure to urine is thought to be lower than that from other bodily fluids, but isolation of intact infectious virus (not simply virus RNA particles) from urine has been confirmed [34], so nevertheless remains a potential risk to providers performing endoscopic urological interventions such as stenting. Therefore, in addition to mask and eye protection, we would recommend waterproof gumboots and shoe covers to be worn.

Conservations of resources

Minimising hospital attendance and length of stay

Due to the highly infectious nature and exponential spread of the COVID-19 virus, combined with estimated rates of severe and critical illness of 13.8% and 6.1%, respectively, there is significant risk that need for inpatient care will overwhelm available resources, this having already occurred in locations such as Iran and Italy. Despite this pressure, emergent non-COVID-19 conditions will continue to occur during the pandemic and need to be triaged and managed. For those presenting with acute manifestations of urolithiasis such as renal colic and infected or obstructed stones, choice of treatment has the potential to significantly affect length of stay in hospital.

While renal colic can frequently be managed conservatively with analgesia enabling patients to be discharged home, these patients are prone to representation, especially those with larger and more proximal stones at initial presentation. There is an associated risk of COVID-19 infection at each healthcare encounter in addition to the potential to develop concurrent urinary tract infection or urosepsis in the interim. A crucial part of deciding which patients are appropriate for outpatient conservative management is stone size and location, with non-contrast CT the established gold standard in imaging to assess this. However, waiting for imaging may contribute to an increased length of stay in the emergency department, a high-risk environment for transmission with significant bed availability pressures.

Therefore, we would recommend that during the extreme pandemic environment, patients presenting with symptoms clinically suspicious for renal colic but without evidence of infection or renal failure may be discharged if pain is adequately controlled, with urgent inpatient imaging performed only in the setting of sepsis, renal failure, uncontrolled pain or a repeat presentation. In patients not meeting these criteria, diagnosis may be confirmed or excluded utilising outpatient imaging services with appropriate contact and distancing precautions where this is able to be safely accessed.

In patients requiring intervention, existing information is unanimous that an infected or obstructed system remains a urological emergency requiring immediate decompression, with ureteric stenting and percutaneous nephrostomy considered equivalent. During the pandemic, this should be done under local anaesthesia wherever possible. Some have speculated that ureteric stenting may be preferable to nephrostomy given the potential for accidental removal of nephrostomy during any delay to definite treatment (which is predicted to be more frequent in the pandemic setting) [23]. In reality, this will need to be evaluated on an individual basis, considering both clinical factors such as anticoagulation status and availability of each procedure, ability to

tolerate either procedure under local anaesthesia, and social factors including home environment and cognitive ability, for example patients with dementias may be at greater risk of inadvertently dislodging a nephrostomy and, therefore, better suited to stenting.

Finally, for patients with pre-existing stents in situ, the majority of the literature favours accepting an extended stent indwelling time of up to 6–12 months to defer definitive management [22]. We agree but would propose there may be a need for some exceptions to be made in patients known to rapidly and severely encrust stents who would be at risk of loss of renal function from this. For patients who have already undergone stone clearance procedures, self-removal of stent via strings at home is an attractive option that will reduce interaction with the healthcare system during the pandemic. It is important to have a stent register system in place to ensure the patient has removed the stent correctly, this can be achieved via telehealth or phone call. Telehealth consultations can also be utilised in other aspects of outpatient stone management, for example review of serial imaging in stone clinics, to reduce patients' number of hospital attendances with potential exposure to COVID-19 in the healthcare environment. Additional considerations while these strategies are in place during an ongoing pandemic may include provision of dissolution therapy to all patients with indwelling stents to reduce risk of encrustation, and consideration of intermittent antibiotic treatment in those prone to infections and urosepsis while stents are in situ as proposed by Proietti et al., referencing prior work by Tenke et al. finding no significant difference between continuous and intermittent levofloxacin treatment in patients with indwelling ureteral stents or nephrostomy [23, 35].

Our recommended initial management of the patient presenting with suspected acute renal colic is summarised by the flowchart (Fig. 1), with potential deviations from usual management outside of the pandemic environment highlighted by greyed boxes or asterisks.

Minimising ICU requirement

Demand on ICU bed and ventilator requirements will be significantly increased by the COVID-19 pandemic, with current evidence reporting up to 12% of all patients with COVID-19 may require ICU treatment, in particular with regard to ventilatory support. In those requiring ventilatory support, this may be for a prolonged time course in each individual [32]. In some situations, demand may result in the need to requisition ventilators from other areas such as theatres.

Patients presenting with urolithiasis may compete for these resources in the setting of urosepsis and severe obstructive renal failure where interventions are performed under general anaesthesia. Decompression with ureteric

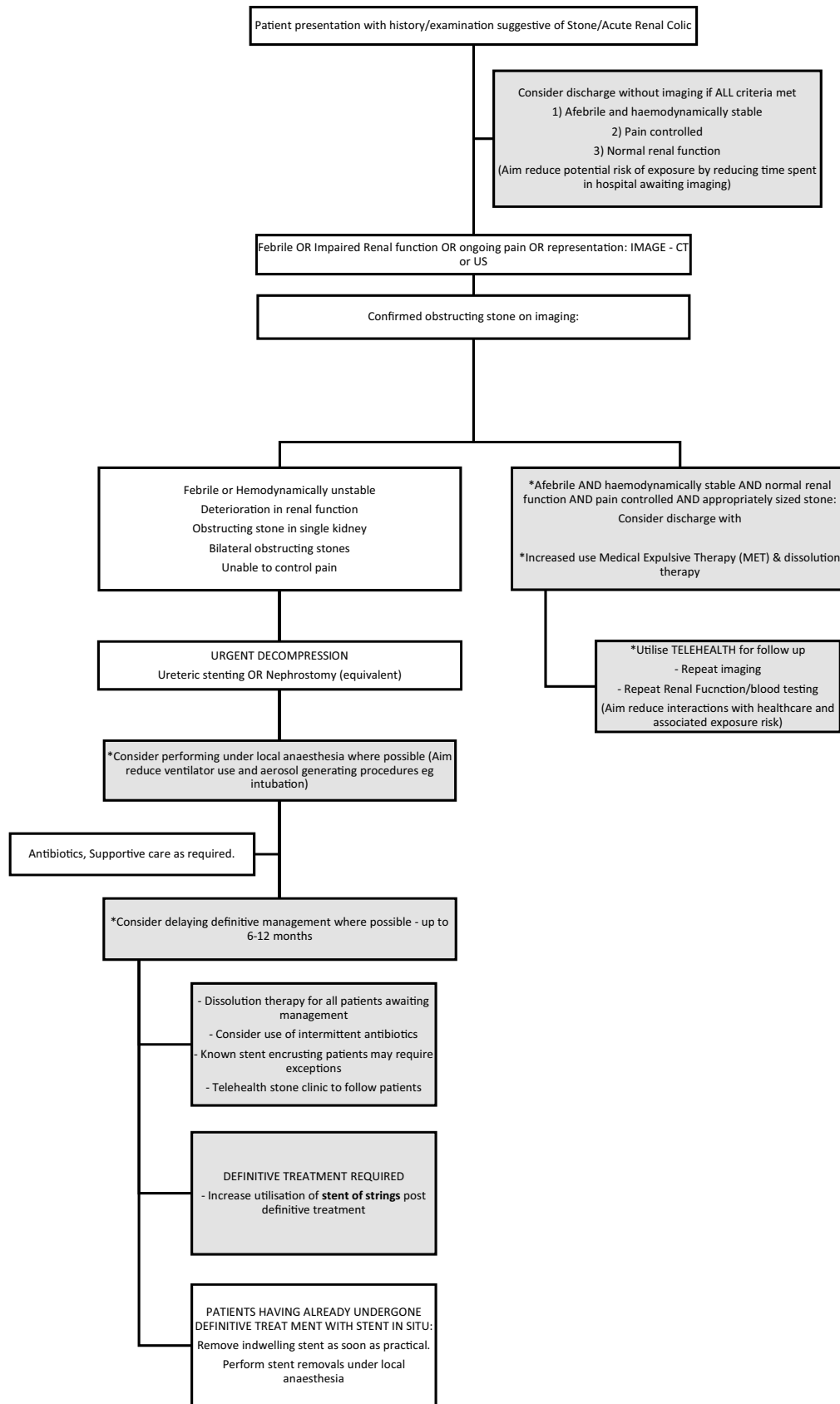


Fig. 1 Recommended initial management of the acute stone presentation during COVID-19 pandemic conditions

stenting is likely to account for the majority of urolithiasis work during the pandemic and as above should be performed under local anaesthesia wherever possible to reduce demand on ventilators.

In those patients presenting with sepsis, little can be done to reduce their risk of requiring ICU support outside of diligence in collecting urine and blood cultures, and ensuring antibiotic treatment is timely and tailored accordingly. As above, in those patients with ureteric stents or nephrostomy left in situ for a prolonged period of time, intermittent antibiotic treatment may be useful to reduce risk of progression to urosepsis [23].

Conservation of PPE

Despite the critical role of PPE in protecting healthcare staff, it has already been demonstrated that current global supply is not meeting demand and many locations have already been forced to resort to increasing the accepted length of use of equipment from single use per patient to using the same piece of equipment for entire shifts or even longer [36]. We would recommend a hierarchy of prioritisation of use of PPE for those staff performing aerosol-generating procedures on known or suspected cases, followed by those otherwise coming into close contact with known or suspected patients, followed by those conducting routine care of all patients.

Anaesthetic implications

Avoidance of aerosol-generating procedures

Tracheal intubation, non-invasive ventilation, tracheostomy and bag mask ventilation are all aerosol-generating procedures. Some evidence also suggests aerosols can be generated by laparoscopy, in particular at the time of desufflation [37].

We have already established that in urolithiasis patients, it is likely the vast majority of operative interventions being conducted during the COVID-19 pandemic will be ureteric stent insertions in the setting of sepsis or obstructive renal failure. Where possible, this should be attempted under local anaesthesia, with conscious sedation an alternative that may help avoid need for ventilation.

In those still requiring general anaesthesia, anaesthetists should have prioritised use of appropriate PPE including gown, gloves, full-face shield, N95 or equivalent mask. Other recommendations include the use of, exhalation filters, and video laryngoscopy wherever possible, and attempt to best utilising preoxygenation to avoid use of bag/mask ventilation [38, 39].

Future considerations

Alterations to best practice are likely to be accepted in the short term as required under the extenuating circumstances of a pandemic.

When this resolves and usual practice resumes a downstream effect on case load can be anticipated. In urolithiasis patients, this may result in an increased overall number of patients, greater stone burden, and increase in encrusted ureteric stents. This may affect proportion of patients undergoing SWL compared to ureteroscopy/pyeloscopy and lithotripsy to PCNL. In addition, urologists will need to triage timing of management of postponed urolithiasis cases with deferred oncological cases, aided by updated radiologic imaging of stone burden.

It is also important to consider how to approach this population of patients awaiting deferred definitive stone management in the situation where COVID-19 is suppressed in the local area, but pandemic conditions are ongoing elsewhere—should cases be expedited, or continue to be deferred to preserve PPE for a potential second or subsequent wave? In this event, we believe expediting follow-up and definite stone management (under appropriate precautions such as pre-operative COVID-19 testing and isolation of patients) would be of greater benefit, not only by treating existing deferred patients and reducing their risk of complications such as urosepsis and encrustation associated with prolonged deferral, but also in reducing the deferred patient population anticipating further deferred cases with any additional wave of COVID-19. With regard to the need to conserve PPE in anticipation of second or subsequent waves, we would anticipate this to be of lesser concern as where COVID-19 is suppressed sufficiently as to allow management of deferred stone cases, it should also be possible for PPE manufacturing to be sufficiently increased as to both supply immediate demand and produce surplus to be stockpiled for the event of a future wave.

Conclusion

In conclusion, it is unavoidable that many patients with urolithiasis will continue to require management during the COVID-19 pandemic. However, it is likely possible to limit interventions to those patients requiring urgent decompression of the collecting system in the setting of obstruction and or infection, where both general guidelines and COVID-19 specific recommendations from peak Urological bodies are in consensus that decompression of the infected obstructed system remains a Urological emergency requiring immediate intervention. Wherever possible this should be attempted under local anaesthesia utilising either ureteric stenting or percutaneous nephrostomy. Currently available guidelines

and existing literature suggest either procedure is equally appropriate, and choice should be based on individual consideration of patient and institution factors. Regarding definitive management of urolithiasis, for the duration of the pandemic patients and Urologists will likely need to accept short-term changes to best practice, in particular deferral of definitive stone clearance procedures and accepting an increased length of indwelling stent time.

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