Clinical Guidelines
for the State of Qatar

The management of urolithiasis

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1 Information about this guideline

1.1 Objective and purpose of the guideline
The purpose of this guideline is to define the appropriate management of urolithiasis in adults. The objective is to reduce inappropriate investigation, prescribing and referral of patients presenting to provider organisations in Qatar. It is intended that the guideline will be used primarily by physicians in primary care and outpatient settings.

1.2 Scope of the guideline
Aspects of care covered within this guideline include:
- Diagnosis and management of urolithiasis in adults (i.e. people over 18 years of age).
- Topics covered include:
  - Stone classification.
  - Investigation.
  - Indications for urgent decompression.
  - Surgical treatment options.
  - Medical treatment options.

Aspects of care not covered within this guideline include:
- Management of urolithiasis in children and adolescents.

1.3 Editorial approach
This guideline document has been developed and issued by the Ministry of Public Health of Qatar (MOPH), through a process which aligns with international best practice in guideline development and localisation. The guideline will be reviewed on a regular basis and updated to incorporate comments and feedback from stakeholders across Qatar.

The editorial methodology, used to develop this guideline, has involved the following critical steps:

- Extensive literature search for well reputed published evidence relating to the topic.
- Critical appraisal of the literature.
- Development of a draft summary guideline.
- Review of the summary guideline with a Guideline Development Group, comprised of practising physicians and subject matter experts from across provider organisations in Qatar.
- Independent review of the guideline by the Clinical Governance body appointed by the MOPH, from amongst stakeholder organisations across Qatar.

Explicit review of the guideline by patient groups was not undertaken.

Whilst the MOPH has sponsored the development of the guideline, the MOPH has not influenced the specific recommendations made within it.

1.4 Sources of evidence
The professional literature published in the English language has been systematically queried using specially developed, customised, and tested search strings. Search strategies are developed to allow efficient yet comprehensive analysis of relevant publications for a given topic and to maximise retrieval of articles with certain desired characteristics pertinent to a guideline.

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For each guideline, all retrieved publications have been individually reviewed by a clinical editor and assessed in terms of quality, utility, and relevance. Preference is given to publications that:

1. Are designed with rigorous scientific methodology.
2. Are published in higher-quality journals (i.e. journals that are read and cited most often within their field).
3. Address an aspect of specific importance to the guideline in question.

Where included, the ‘goal length of stay’ stated within this guideline is supported by and validated through utilisation analysis of various international health insurance databases. The purpose of database analysis is to confirm the reasonability and clinical appropriateness of the goal, as an achievable benchmark for optimal duration of inpatient admission.

1.5 Evidence grading and recommendations

Recommendations made within this guideline are supported by evidence from the medical literature and where possible the most authoritative sources have been used in the development of this guideline. In order to provide insight into the evidence basis for each recommendation, the following evidence hierarchy has been used to grade the level of authoritativeness of the evidence used, where recommendations have been made within this guideline.

Where the recommendations of international guidelines have been adopted, the evidence grading is assigned to the underlying evidence used by the international guideline. Where more than one source has been cited, the evidence grading relates to the highest level of evidence cited:

- **Level 1 (L1):**
  - Meta-analyses.
  - Randomised controlled trials with meta-analysis.
  - Randomised controlled trials.
  - Systematic reviews.

- **Level 2 (L2):**
  - Observational studies, examples include:
    - Cohort studies with statistical adjustment for potential confounders.
    - Cohort studies without adjustment.
    - Case series with historical or literature controls.
    - Uncontrolled case series.
  - Statements in published articles or textbooks.

- **Level 3 (L3):**
  - Expert opinion.
  - Unpublished data, examples include:
    - Large database analyses.
    - Written protocols or outcomes reports from large practices.

In order to give additional insight into the reasoning underlying certain recommendations and the strength of recommendation, the following recommendation grading has been used, where recommendations are made:

- **Recommendation Grade A1 (RGA1):** Evidence demonstrates at least moderate certainty of at least moderate net benefit.

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- **Recommendation Grade A2 (RGA2):** Evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care.

- **Recommendation Grade B (RGB):** Evidence is insufficient, conflicting, or poor and demonstrates an incomplete assessment of net benefit vs harm; additional research is recommended.

- **Recommendation Grade C1 (RGC1):** Evidence demonstrates a lack of net benefit; additional research is recommended.

- **Recommendation Grade C2 (RGC2):** Evidence demonstrates potential harm that outweighs benefit; additional research is recommended.

- **Recommendation of the GDG (R-GDG):** Recommended best practice on the basis of the clinical experience of the Guideline Development Group members.

### 1.6 Guideline Development Group members

The following table lists members of the Guideline Development Group (GDG) nominated by their respective organisations and the Clinical Governance Group. The GDG members have reviewed and provided feedback on the draft guideline relating to the topic. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

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### 1.7 Responsibilities of healthcare professionals

This guideline has been issued by the MOPH to define how care should be provided in Qatar. It is based upon a comprehensive assessment of the evidence as well as its applicability to the national context of Qatar. Healthcare professionals are expected to take this guidance into account when exercising their clinical judgement in the care of patients presenting to them.

The guidance does not override individual professional responsibility to take decisions which are appropriate to the circumstances of the patient concerned. Such decisions should be made in

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¹ Dr Ahmed Babiker attended the MOPH in his capacity as a Clinical Pharmacist and advisor on the availability of medications in Qatar.

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consultation with the patient, their guardians, or carers and should consider the individual risks and benefits of any intervention that is contemplated in the patient’s care.
1.8  Abbreviations used in this guideline
The abbreviations used in this guideline are as follows:

- **CT**: Computed tomography scanning
- **ESWL**: Extracorporeal shock wave lithotripsy
- **HU**: Hounsfield Unit
- **LUTS**: Lower urinary tract symptoms
- **MET**: Medical expulsive therapy
- **NCCT**: Non-contrast-enhanced computed tomography scan
- **NSAID**: Non-steroidal anti-inflammatory drug
- **PNL**: Percutaneous nephrolithotomy
- **URS**: Ureteroscopy
- **UTI**: Urinary tract infection
2 Organisation of care in Qatar

2.1 Role of the Ministry of Public Health
The Ministry of Public Health of Qatar (MOPH) has been given the responsibility to guide reform in Qatar in order to establish one of the world’s most admired and renowned healthcare systems. The MOPH’s role is to create a clear vision for the nation’s health direction, set goals and objectives for the country, design policies to achieve the vision, regulate the medical landscape, protect the public’s health, set the health research agenda, and monitor and evaluate progress towards achieving those objectives.

The MOPH has the dual mandate to develop policies and programmes to improve the people’s health so that they may enjoy longer and more productive lives, and to lay the foundation for a vibrant country for decades to come.

The MOPH does not provide clinical services. Instead its goal is to vest responsibility for care in the hands of both public and private sector healthcare institutions, whilst regulating, monitoring, and evaluating this care against agreed upon outcomes. The MOPH is committed to establishing an environment that promotes quality and wellness through policies in such areas as public health, health insurance, information technology, licensure and credentialing; and continuing medical education.

2.2 Provision of care
Healthcare provision in Qatar comprises of the following main entities:

- Public Sector:
  - Primary care health centres - provided by the Primary Health Care Corporation of Qatar.
  - Secondary and tertiary care hospitals and outpatient clinics - provided by the Hamad Medical Corporation (HMC).
  - Paediatric Emergency Care provided by specialist Paediatric Emergency Centres within HMC.
  - QP Clinics for personnel and families of Qatar Petroleum.
  - Sports Medicine centre provided by a specialist Sport Medicine Hospital – Aspetar.
  - Ministry of Interior clinics for personnel and families of Qatar’s police services.
  - Ministry of Defence clinics for personnel and families of Qatar’s armed forces.
  - Specialist obstetric, gynaecological and paediatric care provided by Sidra Medical & Research Center.

- Private sector:
  - A range of single-handed generalist and specialist clinics.
  - Polyclinics.
  - Specialist hospitals.

The aim of the MOPH’s National Health Strategy is to rebalance healthcare delivery with a greater emphasis on primary and community care and an expansion of the role played by the private sector.
3 Key recommendations of the guideline

The key recommendations of this guideline are:

General recommendation:
- It is recommended that a National Guideline for the management of urolithiasis be created for children and adolescent age groups [R-GDG].

Clinical assessment:
- A full clinical assessment should be undertaken in patients presenting with suspected urolithiasis [R-GDG].

Initial management:
- Where possible and unless there are contraindications, a non-steroidal anti-inflammatory drug (NSAID) should be the first drug of choice for pain relief [2][L1, RGA1].
- Urine tests, blood tests should be performed in an outpatient or Emergency Department setting [R-GDG].
- Ultrasound should be performed as the initial imaging test - unless CT scanning is readily available [R-GDG].

Referral to secondary/specialist care:
- See Section 7.4 for indications for referral to the Emergency Department.
- Patients not meeting the criteria for emergency referral should be referred to the Urology outpatient clinic (see Section 7.5).

Imaging in secondary care:
- Unless contraindicated, a non-contrast-enhanced CT (NCCT) should be performed in all patients referred to the Emergency Department.
- If stone removal is planned and renal collecting system anatomy needs to be assessed, then a contrast study is recommended [2][L3, RGA1].
- NB: Do not delay pain relief or any other emergency measures for imaging assessments [2].

Urgent decompression:
- Urgent urological referral is required to determine if obstruction needs to be relieved and to determine the method and timing of renal drainage [12](see Section 8.2).

Conservative management:
- Can be offered to newly diagnosed patients with [2]:
  - Stones \( \leq 10 \text{ mm} \); and
  - In whom pain can be adequately managed; and
  - No other indications for urgent stone removal are present; and
  - Adequate compliance with the treatment plan and access to healthcare is available.
- Medical expulsive therapy with alpha-blockers should be offered to facilitate ureteral stone passage if conservative management is preferred [2][L1, RGA1].
Surgical treatment:
- Options for definitive treatment include the following (see Section 8.4)[4]:
  - Extracorporeal shock wave lithotripsy.
  - Percutaneous nephrolithotomy.
  - Ureteroscopy and stone extraction.
  - Open or laparoscopic surgery.

Medical treatment:
- Alkalisation of urine is an option for [2,15]:
  - Treatment of uric acid stones.
  - Prevention of cystine stones.

Follow-up:
- Consider stone analysis in all patients in whom a stone is collected [R-GDG].
- Ensure patients with recurrent stone formation [2,15]:
  - Are followed up periodically to monitor the course of their disease.
  - Have their metabolic risk factors identified.
  - Have stone prevention strategies in place.
# Background information

## 4.1 Definition
Urolithiasis is defined as [1]:
- The presence of calculi in the urinary tract system.

Renal/ureteric colic is defined as [1]:
- Paroxysmal pain due to abrupt obstruction of the renal pelvis or ureter. Typically caused by impaction or passage of a calculus.

Urosepsis is defined as [1]:
- Septicaemia resulting from a urinary tract infection (including from obstruction of infected urine).

## 4.2 Incidence and prevalence
Stone incidence depends on geographical, climatic, ethnic, dietary, and genetic factors [2]:
- There is a high incidence of kidney stones in the Gulf region due to an adverse combination of dietary (i.e. high animal protein intake) and environmental factors (i.e. hot, dry climate)[3].
- The incidence of uric acid and calcium oxalate stones is comparatively higher in the Gulf than most Western countries with a comparatively lower incidence of calcium phosphate and infection (Struvite) stones [3].

Recurrence [2]:
- Approximately 50% of people who develop recurrent stones have just one lifetime recurrence.
- Highly recurrent disease is observed in approximately 10% of patients.
- Stone type and disease severity determine whether risk of recurrence is low or high.

## 4.3 Classification and aetiology
Urinary stones can be classified according to [2]:
- Size – stratified into those measuring:
  - <5 mm.
  - 5-10 mm.
  - 10-20 mm.
  - >20 mm.
- Anatomical position, e.g.:
  - Upper, middle, or lower calyx.
  - Renal pelvis.
  - Upper, middle, or distal ureter.
  - Bladder.
- Radiographic characteristics.
- Aetiology of formation.
- Composition.

Stones can be classified into those caused by [2]:
- Infection – infection stones (Struvite stones) e.g.:
  - Magnesium ammonium phosphate.
  - Carbonate apatite.
  - Ammonium urate.

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• Non-infectious causes – non-infection stones, e.g.:
  o Calcium oxalate.
  o Calcium phosphate.
  o Uric acid.
• Adverse drug effects – drug-induced urinary calculi.
• Genetic defects, e.g.:
  o Cystine.
  o Xanthine.
  o 2,8-dihydroxyadenine

Stone classification can also be made by composition [2,4]:
• Calcium oxalate, phosphate, or both [2,5] – typically 70-80% of stones [4]:
  o Calcium oxalate stones are associated with [2]:
    ▪ A small urine volume.
    ▪ Hypercalciuria, hyperoxaluria, hyperuricosuria, high sodium excretion.
    ▪ Hypocitraturia, hypomagnesuria.
    ▪ High animal protein intake.
    ▪ High oxalate intake.
  o Calcium phosphate stones are associated with [2]:
    ▪ Hypercalciuria.
    ▪ Elevated serum calcium
    ▪ Hyperparathyroidism.
    ▪ Renal tubular acidosis.
    ▪ Urinary tract infections (UTI).
• Magnesium ammonium phosphate (Struvite stones) – 2-15% [2]:
  o Associated with UTI caused by a urea-splitting organisms e.g.:
    ▪ Proteus spp.
• Uric acid – approximately 10% of stones [2]:
  o Uric acid stones are associated with hyperuricosuria and acidic urine.
  o Some patients may form mixed stones, e.g. hyperuricosuric calcium oxalate stones.
• Cystine – 1-2% [2]:
  o Result from cystinuria, a genetic disorder.
• Other substances (e.g. xanthine) – 1% [2].

4.4 Higher risk groups
Risk factors for stone formation include:
• Age and gender [5,6]:
  o The risk is higher in men than in women.
  o However, some evidence suggests the risk is becoming more equal because of lifestyle factors, such as obesity.
  o Peak age in men is 30 years; the peak ages in women are 35 years and 55 years.
• Low urine output (<1L/day) caused by [5,7]:
  o Excessive losses; and/or
  o Low fluid intake.
• Urinary pH strongly influences the formation of various types of stones, e.g. [2]:
  o A urine pH of <6.0 increases the risk of uric acid stones.
  o A urine pH of >6.5 increases the risk of calcium phosphate stones.
• Family history [7].
• Certain medications, e.g. [2,8]:
  o Calcium supplements.
5 Presentation

Urolithiasis:
- May be symptomatic or asymptomatic [2].
  - Asymptomatic stones may be found as incidental findings when patients have investigations for other reasons, e.g. ultrasound [9].
- The main symptom is renal/ureteric colic.
- Pain may be accompanied by [7]:
  - Nausea.
  - Vomiting.
  - Haematuria.
  - Lower urinary tract symptoms (LUTS).
  - Constitutional symptoms e.g. fever, malaise.

NB: A full clinical assessment should be undertaken in patients presenting with suspected urolithiasis [R-GDG].

6 Differential diagnosis

The differential diagnosis of urolithiasis includes [7,9,10]:
- Upper UTI.
- Upper urinary tract obstruction due to other causes (e.g. renal or ureteral tumour).
- Gynaecological causes e.g.:
  - Ectopic pregnancy.
  - Ovarian torsion.
- Testicular causes e.g.:
  - Testicular torsion.
  - Acute epididymitis.
- Gastrointestinal:
  - Appendicitis.
  - Diverticulitis.
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- Biliary colic.
- Other:
  - Musculoskeletal pain.
  - Herpes zoster.
  - Pneumonia or pleurisy.

7  Initial management

7.1  Provide analgesia and/or anti-emetics

Analgesia:

- Where possible, unless there are contraindications, a non-steroidal anti-inflammatory drug (NSAID) should be the first drug of choice [2][L1, RGA1]:
  - If an NSAID is not suitable, consider an opiate, if available, such as [2][L3]:
    - Tramadol.
    - Hydromorphone.
    - NB: avoid pethidine as this is particularly associated with vomiting.
- For less severe pain, or for ongoing relief and an NSAID is not suitable, offer paracetamol [7]:
- Considerations for prescribing diclofenac [11]:
  - Is contraindicated in patients with:
    - Asthma.
    - Congestive heart failure.
    - Ischaemic heart disease.
    - Peripheral arterial disease.
    - Cerebrovascular disease.
    - Renal failure.
    - Peptic ulcer disease.
  - Should only be initiated after careful consideration for patients with significant cardiovascular risk factors, such as [11]:
    - Hypertension.
    - Diabetes.
    - Hyperlipidaemia.
    - Smoking.

If necessary, administer a parenteral anti-emetic for the relief of severe nausea and/or vomiting e.g. metoclopramide hydrochloride [7,12].

7.2  Consider home management

Consider home management if [13]:

- Pain and associated symptoms subside spontaneously or after medication; and
- The patient:
  - Has adequate social support.
  - Can be contacted by telephone.
  - Is willing to stay at home.

Offer advice to the patient:

- Advise adequate fluid intake to maintain lightly-coloured urine [2,7].
- Avoid excessive fluid intake during an acute attack of renal colic.

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• Seek urgent medical assistance if [13][L2]:
  o They develop fever or rigors.
  o The pain worsens.
  o They have a rapid recurrence of severe pain.

7.3 Initial investigations
In patients deemed suitable for home management, undertake the following initial investigations in
an outpatient setting [R-GDG]:
• Urine tests [2]:
  o Urinalysis by dipstick or microscopy.
• Blood tests [2]:
  o Complete blood count [2,12][L1, RGA1].
  o Urea, electrolytes and creatinine.
• Imaging [2]:
  o Urinary tract ultrasound.
    ▪ Ultrasound is preferred unless CT scanning is readily available [R-GDG].

7.4 Indications for referral to the Emergency Department
Refer the patient to the Emergency Department, if the patient has renal colic and any of the following
[2,7,10,13]:
• Uncontrolled pain despite adequate analgesia.
• Repeated presentations within a short duration.
• Immunosuppression.
• Pregnancy.
• The patient is at increased risk of acute kidney injury, e.g. if:
  o There is a solitary or transplanted kidney.
  o There is pre-existing chronic kidney disease.
  o Bilateral obstructing stones are suspected.
• Signs of infection.
• Dehydration and oral fluid intake is not possible.
• Oliguric or anuric.
• Bladder or urethral stones on imaging with or without acute urinary retention.
• Elevated creatinine and/or leucocytosis.
• Signs of acute obstruction on imaging.
• Social circumstances do not meet the criteria for home management, e.g.:
  o Telephone contact is not possible.
  o No reliable social support.
• There is uncertainty about the diagnosis and the patient is acutely symptomatic.
• The patient prefers to be admitted.

7.5 Elective referral to secondary/specialist care
For patients who do not meet the criteria for emergency referral:
• Refer to a urology outpatient clinic, if any of the following apply [R-GDG]:
  o Signs of obstruction on imaging but with:
    ▪ Normal renal function; and
    ▪ Controlled symptoms.
  o Confirmed non-obstructing renal stone on imaging.
8 Specialist management of urolithiasis

8.1 Investigation
Undertake the following investigations:

- Urine tests [2]:
  - Urinalysis by dipstick or microscopy.
  - Urine culture and sensitivity.

- Blood tests [2,12][L1, RGA1]:
  - Complete blood count.
  - Urea, electrolytes and creatinine.
  - Coagulation profile, if intervention is planned.
  - Blood culture if infection is suspected, patient is clinically unwell or has fever.

- Imaging [2]:
  - Non-contrast-enhanced CT (NCCT) (unless contraindicated):
    - NB: Do not delay pain relief or the above tests for imaging assessments [2].
    - If stone removal is planned and renal collecting system anatomy needs to be assessed, then a contrast study is recommended [2][L3, RGA1].

NB: Urinary tract ultrasound:
- Ultrasound is preferred as the initial imaging test in the Emergency Department setting unless CT scanning is readily available [R-GDG].

8.2 Indications for urgent decompression
Urgent urological referral is required to determine if obstruction needs to be relieved and to determine the method and timing of renal drainage [12]:

- Decompress the renal collecting system, if the patient has [2,12]:
  - Sepsis or an infected obstructed kidney [2][L1, RGA1]:
    - The obstructed kidney with signs of UTI is a urological emergency.
    - Delay definitive treatment of the stone until the infection is cleared following a complete course of antimicrobial therapy.
  - A single functioning kidney or bilateral obstruction.
  - Intractable pain.

- Urgently decompress the collecting system using [2][L1, RGA1]:
  - Percutaneous drainage; or
  - Ureteral stenting.

Following urgent decompression [2][L2, RGA2]:
- Send both urine and blood samples for culture and sensitivity testing.
- Initiate antibiotics immediately, if not already started.

8.3 Consider a trial of conservative management or medical expulsive therapy
Conservative management [2]:

- Can be offered to newly diagnosed patients with:
  - Stones ≤10 mm; and
  - In whom pain can be adequately managed; and
  - No other indications for urgent stone removal are present; and
  - Adequate compliance with the treatment plan and access to healthcare is available.
Consider medical expulsive therapy (MET):

- MET should be offered to facilitate ureteral stone passage if conservative management is preferred [2][L1, RGA1].
- For MET [2]:
  - Alpha blockers are recommended [2][L1, RGA1].
  - Patients should be followed up once within 2 weeks to monitor for stone position and hydronephrosis [2][L3, RGA2].
  - Discontinue treatment if complications develop, e.g. [2]:
    - Infection.
    - Refractory pain.
    - Deterioration of renal function.
- NB: Patients should be counselled about the risks of MET, including drug side effects [2].

8.4 Surgical treatment

Stone removal [2,14]:

- A variety of techniques are available, depending on:
  - The number of stones.
  - The size of the stones.
  - The stone site and type.
- These techniques include:
  - Extracorporeal shockwave lithotripsy.
  - Percutaneous nephrolithotomy.
  - Ureteroscopic techniques.
  - Open or laparoscopic surgery.

8.4.1 Extracorporeal shock wave lithotripsy

Extracorporeal shock wave lithotripsy (ESWL) [2]:

- May be an option for stones ≤20 mm in the renal pelvis and upper or middle calices.
- Is unlikely to be successful, in the following:
  - For renal stones >15 mm in diameter at the lower renal pole.
  - For ureteral stones >10mm in diameter.
  - Shockwave-resistant stones e.g.:
    - Stones with density >1,000 HU.
    - Cystine stones.
- Contraindications include [2]:
  - UTI.
  - Pregnancy.
  - Lower ureteric stones in women of child-bearing age.
  - Bleeding diathesis.
  - Arterial aneurysm in the vicinity of the stone.
  - Severe skeletal malformations.
  - Morbid obesity.
  - Anatomical obstruction distal to the stone.

To facilitate clearance after ESWL, MET may be useful [2].

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8.4.2 Percutaneous nephrolithotomy
Percutaneous nephrolithotomy (PNL) [2]:
- Is the preferred treatment for removal of:
  - Renal stones >20 mm in diameter.
  - Ureteral stones that:
    - Cannot be accessed via a retrograde approach; or
    - Are not amenable to ESWL.
- Contraindications [2]:
  - UTI.
  - Anticoagulant therapy.
  - Potential malignant kidney tumour.
  - Pregnancy.
- Consider placing a nephrostomy tube or ureteric stent at the end of the PNL procedure [2].

8.4.3 Ureteroscopy and stone extraction
Consider Ureteroscopy (URS) (semi-rigid or flexible) [2]:
- For the removal of larger renal stones (>20 mm) if PNL is not possible [2][L2, RGA2].
  - However, there may be a higher risk that a follow-up procedure and placement of a ureteral stent may be needed.
- For the removal of ureteric stones.
- Failure of conservative treatment with MET.
- For patients with an uncorrected bleeding disorder or on continued antithrombotic therapy:
  - URS may be an alternative option, as it is associated with less morbidity than ESWL or PNL.

NB: There are no specific contraindications to URS other than UTI.

Stenting in URS [2]:
- In uncomplicated URS, routine stenting may not be necessary.
- Ureteral stents should be inserted in patients who are at increased risk of complications.
- An alpha-blocker can reduce the rate of stent-related symptoms.
- In all patients, perioperative antibiotic prophylaxis is recommended.

8.4.4 Open and laparoscopic surgical stone extraction
Open or laparoscopic surgery may be considered in rare cases in which ESWL, URS and PNL have failed or are unlikely to be successful [2][L2].

8.5 Medical treatment
Alkalinisation of urine is an option for [2, 15]:
- Treatment of uric acid stones.
- Prevention of cystine stones.

Works by alkalinisation of urine through the use of alkaline citrate or sodium bicarbonate. For information on the stone composition and type, consider the following prior to chemolysis [2, 15]:
- Stone analysis.
- Urinary pH measurement.

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• Radiographic characteristics.

NB: It cannot be used for Struvite stones.

8.6 Follow-up
Consider stone analysis in all patients in whom a stone is collected [R-GDG].

Ensure patients with recurrent stone formation [2,15]:
• Are followed up periodically to monitor the course of their disease.
• Have their metabolic risk factors identified.
• Have stone prevention strategies in place.
9 References