

# Renal and ureteric stones: assessment and management

NICE guideline

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The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

All problems (adverse events) related to a medicine or medical device used for treatment or in a procedure should be reported to the Medicines and Healthcare products Regulatory Agency using the [Yellow Card Scheme](#).

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should [assess and reduce the environmental impact of implementing NICE recommendations](#) wherever possible.

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This guideline is the basis of QS195.

## Overview

This guideline covers assessing and managing renal and ureteric stones. It aims to improve the detection, clearance and prevention of stones, so reducing pain and anxiety, and improving quality of life.

## Who is it for?

- Healthcare professionals
- Commissioners and providers
- People with renal and ureteric stones, their families and carers

# Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in [NICE's information on making decisions about your care](#).

[Making decisions using NICE guidelines](#) explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

## 1.1 Diagnostic imaging

- 1.1.1 Offer urgent (within 24 hours of presentation) low-dose non-contrast CT to adults with suspected renal colic. If a woman is pregnant, offer ultrasound instead of CT.
- 1.1.2 Offer urgent (within 24 hours of presentation) ultrasound as first-line imaging for [children and young people](#) with suspected renal colic.
- 1.1.3 If there is still uncertainty about the diagnosis of renal colic after ultrasound for children and young people, consider low-dose non-contrast CT.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on diagnostic imaging](#).

Full details of the evidence and the committee's discussion are in [evidence review B: imaging for diagnosis](#).

## 1.2 Pain management

- 1.2.1 Offer a non-steroidal anti-inflammatory drug (NSAID) by any route as first-line treatment for adults, children and young people with suspected renal colic.
- 1.2.2 Offer intravenous paracetamol to adults, children and young people with suspected renal colic if NSAIDs are contraindicated or are not giving sufficient pain relief.
- 1.2.3 Consider opioids for adults, children and young people with suspected renal colic if both NSAIDs and intravenous paracetamol are contraindicated or are not giving sufficient pain relief.
- 1.2.4 Do not offer antispasmodics to adults, children and young people with suspected renal colic.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on pain management](#).

Full details of the evidence and the committee's discussion are in [evidence review E: pain management](#).

## 1.3 Medical expulsive therapy

- 1.3.1 Consider alpha blockers for adults, children and young people with distal ureteric stones less than 10 mm.

In January 2019, this was an off-label use of alpha blockers. See [NICE's information on prescribing medicines](#).

For a short explanation of why the committee made this recommendation and how it might affect practice, see the [rationale and impact section on medical expulsive therapy](#).

Full details of the evidence and the committee's discussion are in [evidence review D: medical expulsive therapy](#).

## 1.4 Stenting before shockwave lithotripsy

- 1.4.1 Do not offer pre-treatment stenting to adults having shockwave lithotripsy (SWL) for ureteric or renal stones.
- 1.4.2 Consider pre-treatment stenting for children and young people having SWL for renal staghorn stones.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on stenting before shockwave lithotripsy](#).

Full details of the evidence and the committee's discussion are in [evidence review H: stents before surgery](#).

## 1.5 Surgical treatments (including shockwave lithotripsy)

### Renal stones

- 1.5.1 Consider watchful waiting for asymptomatic renal stones in adults, children and young people if:
- the stone is less than 5 mm or
  - the stone is larger than 5 mm and the person (or their family or carers, as



appropriate) agrees to watchful waiting after an informed discussion of the possible risks and benefits.

- 1.5.2 Follow the recommendations in table 1 for surgical treatment (including SWL) of renal stones in adults, children and young people.

**Table 1 Surgical treatment (including SWL) of renal stones in adults, children and young people**

Stone type and size	Treatment for adults (16 years and over)	Treatment for children and young people (under 16 years)
Renal stone less than 10 mm	Offer SWL Consider URS: <ul style="list-style-type: none"> <li>• if there are contraindications for SWL <b>or</b></li> <li>• if a previous course of SWL has failed <b>or</b></li> <li>• because of anatomical reasons, SWL is not indicated</li> </ul> Consider PCNL if SWL and URS have failed to treat the current stone or they are not an option	Consider URS or SWL Consider PCNL if: <ul style="list-style-type: none"> <li>• URS or SWL have failed <b>or</b></li> <li>• for anatomical reasons, PCNL is the more favourable option</li> </ul>
Renal stone 10 to 20 mm	Consider URS or SWL Consider PCNL if URS or SWL have failed	Consider URS, SWL or PCNL
Renal stone larger than 20 mm, including staghorn stones	Offer PCNL Consider URS if PCNL is not an option	Consider URS, SWL or PCNL

Abbreviations: PCNL, percutaneous nephrolithotomy; SWL, shockwave lithotripsy; URS, ureteroscopy.

Use clinical judgement when considering mini or standard PCNL for children and young people under 16 years with renal stones greater than 10 mm, including staghorn stones.

Use clinical judgement when considering tubeless, mini or standard PCNL, and supine and prone positions for adults (16 years and over) with renal stones greater than 20 mm, including staghorn stones.

## Ureteric stones

1.5.3 Follow the recommendations in table 2 for surgical treatment (including SWL) of ureteric stones in adults, children and young people.

**Table 2 Surgical treatment (including SWL) of ureteric stones in adults, children and young people**

Stone type and size	Treatment for adults (16 years and over)	Treatment for children and young people (under 16 years)
Ureteric stone less than 10 mm	Offer SWL Consider URS if: <ul style="list-style-type: none"> <li>stone clearance is not possible within 4 weeks with SWL <b>or</b></li> <li>there are contraindications for SWL <b>or</b></li> <li>the stone is not targetable with SWL <b>or</b></li> <li>a previous course of SWL has failed</li> </ul>	Consider URS or SWL
Ureteric stone 10 to 20 mm	Offer URS Consider SWL if local facilities allow stone clearance within 4 weeks Consider PCNL for impacted proximal stones when URS has failed	Consider URS or SWL

Abbreviations: PCNL, percutaneous nephrolithotomy; SWL, shockwave lithotripsy; URS, ureteroscopy.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on surgical treatments \(including shockwave lithotripsy\)](#).

Full details of the evidence and the committee's discussion are in [evidence review F: surgical treatments](#).

## Timing of surgical treatment (including SWL) for adults with ureteric stones and renal colic

1.5.4 Offer surgical treatment (including SWL) to adults with ureteric stones and renal colic within 48 hours of diagnosis or readmission, if:

- pain is ongoing and not tolerated **or**
- the stone is unlikely to pass.

For a short explanation of why the committee made this recommendation and how it might affect practice, see the [rationale and impact section on timing of surgical treatment](#).

Full details of the evidence and the committee's discussion are in [evidence review G: timing of surgery](#).

## Medical expulsive therapy as an adjunct to SWL for adults with ureteric stones less than 10 mm

1.5.5 Consider alpha blockers as adjunctive therapy for adults having SWL for ureteric stones less than 10 mm.

In January 2019, this was an off-label use of alpha blockers. See [NICE's information on prescribing medicines](#).

For a short explanation of why the committee made this recommendation and how it might affect practice, see the [rationale and impact section on medical expulsive therapy as adjunctive to shockwave lithotripsy](#).

Full details of the evidence and the committee's discussion are in [evidence review D: medical expulsive therapy](#).

## 1.6 Stenting after ureteroscopy for adults with ureteric stones less than 20 mm

- 1.6.1 Do not routinely offer post-treatment stenting to adults who have had ureteroscopy for ureteric stones less than 20 mm.

For a short explanation of why the committee made this recommendation and how it might affect practice, see the [rationale and impact section on stenting after ureteroscopy](#).

Full details of the evidence and the committee's discussion are in [evidence review I: stents after surgery](#).

## 1.7 Metabolic testing

- 1.7.1 Consider stone analysis for adults with ureteric or renal stones.
- 1.7.2 Measure serum calcium for adults with ureteric or renal stones.
- 1.7.3 Consider referring children and young people with ureteric or renal stones to a paediatric nephrologist or paediatric urologist with expertise in this area for assessment and metabolic investigations.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on metabolic testing](#).

Full details of the evidence and the committee's discussion are in [evidence review A: metabolic investigations](#).

## 1.8 Preventing recurrence

### Dietary and lifestyle advice

- 1.8.1 Discuss diet and fluid intake with the person (and their family or carers, as appropriate), and advise:
- adults to drink 2.5 to 3 litres of water per day, and children and young people (depending on their age) 1 to 2 litres
  - adding fresh lemon juice to drinking water
  - avoiding carbonated drinks
  - adults to have a daily salt intake of no more than 6 g, and children and young people (depending on their age) 2 to 6 g
  - not restricting daily calcium intake, but maintaining a normal calcium intake of 700 to 1,200 mg for adults, and 350 to 1,000 mg per day for children and young people (depending on their age).
- 1.8.2 Follow the recommendations on maintaining a healthy lifestyle in the [NICE guideline on preventing excess weight gain](#).

### Potassium citrate

The following recommendations apply alongside the recommendations on dietary and lifestyle advice.

- 1.8.3 Consider potassium citrate for adults with a recurrence of stones that are predominantly (more than 50%) calcium oxalate.

In January 2019, this was an off-label use of potassium citrate. See [NICE's information on prescribing medicines](#).

- 1.8.4 Consider potassium citrate for children and young people with a recurrence of stones that are predominantly (more than 50%) calcium oxalate, and with hypercalciuria or hypocitraturia.

## Thiazides

The following recommendation applies alongside the recommendations on dietary and lifestyle advice.

- 1.8.5 Consider thiazides for adults with a recurrence of stones that are predominantly (more than 50%) calcium oxalate and hypercalciuria, after restricting their sodium intake to no more than 6 g a day.

In January 2019, this was an off-label use of thiazides. See [NICE's information on prescribing medicines](#).

For a short explanation of why the committee made these recommendations and how they might affect practice, see the [rationale and impact section on preventing recurrence](#).

Full details of the evidence and the committee's discussion are in [evidence review C: dietary interventions](#) and [evidence review K: prevention of recurrence](#).

## Terms used in this guideline

### Children and young people

People under 16 years.

# Recommendations for research

The guideline committee has made the following key recommendations for research.

## 1 Metabolic assessment

What is the clinical and cost effectiveness of full metabolic assessment compared with standard advice alone, in people with recurrent calcium oxalate stones?

For a short explanation of why the committee made the recommendation for research, see the [rationale on metabolic testing](#).

Full details of the evidence and the committee's discussion are in [evidence review A: metabolic investigations](#).

## 2 Alpha blockers and ureteroscopy

What is the clinical and cost effectiveness of tamsulosin as an adjunct to ureteroscopy?

For a short explanation of why the committee made the recommendation for research, see the [rationale on medical expulsive therapy as adjunctive to shockwave lithotripsy](#).

Full details of the evidence and the committee's discussion are in [evidence review D: medical expulsive therapy](#).

## 3 Preventive treatment following shockwave lithotripsy

What is the clinical and cost effectiveness of empirical potassium citrate or bendroflumethiazide as preventive treatment for people with small residual fragments following shockwave lithotripsy for renal and ureteric stones?

For a short explanation of why the committee made the recommendation for research, see the [rationale on preventing recurrence](#).

Full details of the evidence and the committee's discussion are in [evidence review C: dietary interventions](#) and [evidence review K: prevention of recurrence](#).

## 4 Frequency of follow-up imaging

What is the clinical and cost effectiveness of 6-monthly imaging for 3 years for people with recurrent calcium renal or ureteric stones?

For a short explanation of why the committee made the recommendation for research, see the [rationale on frequency of follow-up imaging](#).

Full details of the evidence and the committee's discussion are in [evidence review J: imaging for follow-up](#).

## 5 Non-steroidal anti-inflammatory drugs (NSAIDs) – route of administration

What is the most clinically and cost effective route of administration for NSAIDs in the management of acute pain thought to be due to renal or ureteric stones?

For a short explanation of why the committee made the recommendation for research, see the [rationale on pain management](#).

Full details of the evidence and the committee's discussion are in [evidence review E: pain management](#).



## Rationale and impact

These sections briefly explain why the committee made the recommendations and how they might affect practice. They link to details of the evidence and a full description of the committee's discussion.

## Diagnostic imaging

[Recommendations 1.1.1 to 1.1.3](#)

### Why the committee made the recommendations

Limited evidence showed that MRI, ultrasound and plain abdominal radiograph were not as good as non-contrast CT for detecting renal and ureteric stones in adults. CT is more expensive than ultrasound or plain abdominal radiograph but the extra cost is likely to be outweighed by avoiding additional investigations when a first test misses the diagnosis. The committee agreed that CT should be performed as soon as possible because renal function can decline quickly. However, they acknowledged that it could be delayed for up to 24 hours if needed (for example, in some locations and when first presentation is out of hours). The committee agreed that CT should not be offered to everyone with abdominal pain, only those with suspected renal colic. They also noted that CT should not be used for pregnant women because of the radiation exposure, and agreed that ultrasound is the preferred imaging modality in this group.

Limited evidence on the use of ultrasound showed that it was not as good as CT for detecting renal and ureteric stones in children and young people. There is known to be widespread variation in the quality of ultrasound. The committee acknowledged that although CT is a better test, there is serious concern about radiation exposure in children and young people and they were keen to minimise this. They agreed that ultrasound should be offered first, and that low-dose non-contrast CT should only be considered if there is still uncertainty about the diagnosis after ultrasound.

### How the recommendations might affect practice

The recommendations reflect current practice so the committee agreed there should be no change.

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## Pain management

[Recommendations 1.2.1 to 1.2.4](#)

### Why the committee made the recommendations

#### NSAIDs

Evidence showed that non-steroidal anti-inflammatory drugs (NSAIDs) reduced the need for rescue medication compared with opioids, antispasmodics and intravenous paracetamol. NSAIDs also reduced pain and had fewer adverse effects. NSAIDs had a better balance of benefits and costs, so the committee agreed that these should be offered as a first-line treatment for people with suspected renal colic.

The committee discussed the route of administration for NSAIDs and noted that most studies used intravenous or intramuscular NSAIDs. They agreed that oral or rectal NSAIDs are more commonly used in UK practice. The committee were concerned that there was very little evidence that oral or rectal NSAIDs were as effective as intravenous or intramuscular NSAIDs, and were reluctant to recommend a significant change in practice that would have resource implications. Therefore, they were not able to specify a particular route of administration of NSAIDs, but did agree to make a [recommendation for research on route of administration](#) to inform future practice.

#### Paracetamol

Some evidence showed a benefit of paracetamol for pain relief when compared with opioids. The committee noted that most of the evidence was based on intravenous paracetamol, which differs from other routes of administration in terms of potency and speed of action. They agreed this benefit could not be generalised to other routes of administration, such as oral. This difference in mechanism of action was not believed to be as strong for other drugs such as NSAIDs. They recommended that intravenous paracetamol should be offered if NSAIDs cannot be used or have not been effective.

## Opioids

There was no benefit of opioids for pain relief over NSAIDs or paracetamol. The committee noted concerns around opioid use in terms of dependency and misuse. However, opioids showed a benefit compared with antispasmodics in terms of pain relief, and there was no difference between opioids and most comparators in terms of adverse events. The committee agreed that opioids could only be considered if both NSAIDs and intravenous paracetamol were contraindicated or not effective.

## Antispasmodics

Antispasmodics offered no benefit in terms of pain relief when compared with NSAIDs. The committee also highlighted that in the studies antispasmodics were given intravenously, whereas in clinical practice an oral route is often used. The committee discussed how antispasmodics can be more difficult to administer intravenously, because of an increased risk of adverse events and a need for intensive monitoring. They agreed that antispasmodics should not be offered to people with suspected renal colic.

## Combination treatments

Very limited evidence from small single studies showed some benefit of a combination of NSAIDs and oral paracetamol, for pain relief, and no increase in adverse events. The committee noted that in practice, 2 drugs would not be given at the same time, but a second would usually be given in a staged manner if the first drug hadn't worked. They noted that people with recurrent stones may self-manage with both oral paracetamol and NSAIDs and so it is important to ask people presenting with suspected renal colic about previous analgesia use. Overall, they agreed that there was not enough convincing evidence for any of the combination treatments.

## Children and young people

All the identified evidence was for adults with renal or ureteric stones. However, the committee agreed that it would be reasonable to extrapolate the evidence on pain relief to children and young people and to include this age group in the recommendations.

## How the recommendations might affect practice

Currently, intravenous paracetamol is not used routinely for managing pain in people with

acute renal colic, but is used in other areas of secondary care (for example, analgesia during surgery). Extending its use into other clinical areas (for example, emergency departments and surgical assessment units) will mean changes in policy and additional training for staff. Therefore, this recommendation will require a change from current practice by most or all providers. The use of intravenous paracetamol may also have some implications for practice if more hospital attendances are required to administer the treatment.

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## Medical expulsive therapy

### [Recommendation 1.3.1](#)

### Why the committee made the recommendation

Evidence showed that in adults, both alpha blockers and calcium channel blockers improved passage of distal ureteric stones of less than 10 mm compared with no treatment. Alpha blockers also improved stone passage when compared with placebo. Alpha blockers offered more benefit than calcium channel blockers in terms of stone passage, and had some benefits in terms of hospital stay and pain, but there was no difference in time to stone passage and quality of life. Evidence was mixed in terms of adverse events. The committee agreed that alpha blockers could be considered for adults with small (less than 10 mm) distal ureteric stones.

Limited evidence in children showed that alpha blockers improved stone passage and time to stone passage, and decreased pain compared with no treatment or placebo. They were not associated with any more adverse events so the committee agreed that alpha blockers could be considered for children and young people with distal ureteric stones less than 10 mm.

There was not enough evidence for the committee to make recommendations for proximal or mid-ureteric stones in adults, children and young people.

Medical expulsive therapy (MET) is low cost, and the savings from interventions avoided because of this therapy, are likely to offset the cost of the therapy.

## How the recommendation might affect practice

Current practice is varied, but many healthcare professionals do not offer alpha blockers for managing symptomatic ureteric stones. Up to 2015, MET was recommended practice in the UK to aid the passage of small ureteric stones. This changed after the SUSPEND trial (Pickard et al. 2015), the largest randomised controlled trial on this subject, concluded that there was no benefit in using alpha blockers. The committee reviewed all the available evidence, some of which was more recent than the SUSPEND trial, and agreed that alpha blockers can help the passage of small ureteric stones and the management of pain.

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## Stenting before shockwave lithotripsy

[Recommendations 1.4.1 and 1.4.2](#)

### Why the committee made the recommendations

No evidence was found for the use of stents before ureteroscopy or percutaneous nephrolithotomy.

#### Adults with renal or ureteric stones

The committee reviewed evidence for the use of stents before treating renal and ureteric stones with shockwave lithotripsy (SWL). No benefits were identified in the use of pre-treatment stents and there were adverse events associated with stent use. These included frequency, urgency and dysuria. The committee agreed that having a stent in place may impede treatment by stopping shockwaves from reaching the stone. They agreed that pre-treatment stenting is not needed for people having SWL, because it does not significantly improve outcomes.

There was no evidence for ureteric or renal stones less than 10 mm, and no evidence for ureteric stones greater than 20 mm. The committee agreed that stone size should not be specified in the recommendation because for small renal stones, current practice is not to stent, and for small ureteric stones, although current practice does sometimes include stenting for reasons such as ongoing pain and obstruction, evidence has shown that treatment within 48 hours is beneficial, and this would avoid the use of stents. Ureteric stones greater than 20 mm are unlikely to be treated with SWL and therefore the

recommendation would not apply to this group.

### **Children and young people with renal stones of less than 10 mm**

Limited evidence from 1 non-randomised study showed a benefit of pre-treatment stenting for children having SWL for renal stones less than 10 mm. However, the committee had concerns about the methods used in the study. They also agreed that the evidence was inconsistent with clinical practice. The committee decided that the evidence was not convincing enough to make a recommendation.

### **Children and young people with renal staghorn stones**

Limited evidence from 1 non-randomised study showed an overall benefit of pre-treatment stenting for children having SWL for renal staghorn stones. Rates of readmission and other procedures were significantly lower in children who had had a stent. They agreed that the evidence was not strong enough to recommend that this should be offered to all children with renal staghorn stones, but it could be considered.

## **How the recommendations might affect practice**

The recommendations broadly reflect current practice.

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## **Surgical treatments (including shockwave lithotripsy)**

[Recommendations 1.5.1 to 1.5.3](#)

## **Why the committee made the recommendations**

### **Asymptomatic renal stones**

The committee noted that in current practice, watchful waiting may be used for people with asymptomatic renal stones, because these stones are not likely to affect quality of life and may pass spontaneously without intervention. This is particularly the case for stones

less than 5 mm, but may also apply to larger stones. The committee noted that larger stones are more likely to have risks associated with watchful waiting. For example, the stone's location may change and cause obstruction, there may be infection or bleeding, or the person may become symptomatic. The committee agreed that watchful waiting may be particularly beneficial for people with complex comorbidities that make surgery a higher risk. They agreed that watchful waiting should be considered for those with asymptomatic renal stones less than 5 mm, and for stones larger than 5 mm as long as the possible risks and benefits have been discussed with the patient.

### **Adults, ureteric stones, less than 10 mm**

Some evidence showed a small benefit of ureteroscopy (URS) over SWL for stone removal, the number of repeat treatments needed and quality of life, but there was a shorter hospital stay, less pain and fewer major adverse events with SWL. Economic analysis showed that SWL offered a better balance of benefits and costs than URS, even when the possible need for repeat treatment was taken into account. The cost differences were substantial, and sensitivity analysis showed economic benefit for SWL even with lower SWL success rates. The committee therefore agreed to offer the less-invasive procedure of SWL to treat small ureteric stones (less than 10 mm) in adults.

However, they acknowledged that prompt treatment of these stones is needed because of the risk of obstruction and kidney damage. URS may be considered as an alternative treatment if, for example, stone clearance is not possible within 4 weeks with SWL, there are contraindications to SWL, the stone is not targetable, or a course of SWL has previously failed (because patients tend to form the same type of stones).

### **Adults, ureteric stones, 10 to 20 mm**

Evidence showed a benefit of URS over SWL for stone removal and the number of repeat treatments needed, but there was a shorter hospital stay, less pain and fewer major adverse events with SWL.

Prompt treatment of ureteric stones is needed because of the risk of obstruction and kidney damage. The risk is even greater with larger stones.

The committee acknowledged that in terms of costs, SWL may offer better value; however, the committee were very concerned about the risks in using SWL for larger ureteric stones. SWL may be delayed because of availability of a lithotripter and the total time to

clear the stone will increase if multiple sessions are needed. Additionally, the effectiveness of SWL can vary with the type of machine used (fixed/mobile) and operator skill. The committee agreed to recommend URS for adults with ureteric stones of 10 to 20 mm, but SWL can be considered if local facilities allow stone clearance within 4 weeks.

Evidence (mainly in a group with impacted stones) suggested a benefit of percutaneous nephrolithotomy (PCNL) for stone removal compared with URS, but there was a shorter hospital stay with URS. The committee agreed that PCNL is not usually performed in the UK for this indication, but that it could be considered for larger impacted stones, particularly in the proximal ureter.

### **Adults, ureteric stones, greater than 20 mm**

No evidence was identified, and the committee agreed that this is a very small group. Usual practice depends on local availability of treatments and expertise. The committee decided that they could not make a recommendation for this group.

### **Adults, renal stones, less than 10 mm**

There was evidence comparing SWL with URS, SWL with PCNL and surgical treatment including SWL with non-surgical treatment (observation or MET). The evidence suggested a benefit of URS in terms of retreatment rate and ancillary procedures, and a benefit of SWL in terms of readmission, failed technology and major adverse events. Limited evidence from 1 small study suggested a benefit of PCNL over SWL in terms of stone-free state and ancillary procedures. There was also evidence of a benefit of surgery compared with non-surgical treatment (observation or MET).

Because SWL offered a better balance of benefits and costs, the committee agreed that it should be offered in the first instance, and that URS should be considered if there are contraindications for SWL, or anatomical reasons or multiple stones, or a previous course of SWL has failed. Because of concerns around the limited evidence for PCNL, this should only be considered as an option when both SWL and URS have failed or are not an option.

### **Adults, renal stones, 10 to 20 mm**

Some evidence showed a benefit of SWL in terms of length of stay, quality of life and some major adverse events, compared with URS and PCNL. Both URS and PCNL had clinical benefits in terms of stone-free state, retreatment rate and ancillary procedures,



compared with SWL. There was no difference between PCNL and URS for most outcomes. One study showed a benefit of surgery in terms of ancillary procedures and stone-free state compared with non-surgical treatment (observation), and 1 study showed a benefit of tubeless compared with standard PCNL in terms of stone-free state.

The committee agreed that URS or SWL offered a better balance of benefits and costs compared with PCNL, and this intervention should be considered only if URS or SWL have failed. In terms of a choice between URS and SWL, the size of the stone was a concern for the committee; however, factors such as quality of life and the risks associated with larger stones were difficult to quantify in any costing work. The committee agreed that the stone size itself would be a factor in the treatment decision, because effectiveness of SWL can also vary by stone size, and a stone nearer to the lower end of the range (10 to 20 mm) could be an appropriate candidate for SWL. Overall, the committee felt that a recommendation to consider URS or SWL would allow flexibility for clinicians in choosing a treatment option. The committee agreed that they did not have enough confidence in the evidence to recommend tubeless over standard PCNL, but agreed that either approach could be used, according to clinical judgement.

### **Adults, renal stones, larger than 20 mm**

Current practice for renal stones greater than 20 mm is PCNL, and the committee agreed that there was insufficient evidence to change this. However, the committee considered that PCNL may not always be an option (for example, for people with high comorbidity, anaesthetic risks or anatomical considerations), and so URS could be considered in these circumstances. The committee agreed that all evidence for types of PCNL was based on small studies, and there was no difference between them for many outcomes. Therefore, any approach should be available and considered based on clinical judgement.

### **Adult, renal stones, staghorn**

There was no evidence for renal staghorn stones in adults. Current practice for these stones is to use PCNL. The committee agreed that staghorn stones are all over 20 mm and so would be treated as renal stones larger than 20 mm.

### **Children and young people, ureteric stones, less than 10 mm**

Limited evidence from a single, small study showed a benefit of URS over SWL in terms of stone-free state, retreatment rate and ancillary procedures. The committee agreed to

recommend SWL as the first treatment for these stones in adults because of the better balance of benefits and costs. However, they noted that evidence for children and young people was much more limited. They also discussed that unlike adults, children usually require a general anaesthetic for each session of SWL. Because both URS and SWL are used in current practice, the committee agreed that either could be considered for children and young people with stones less than 10 mm.

### **Children and young people, ureteric stones, 10 to 20 mm**

No evidence was identified so the committee made a recommendation based on their knowledge and experience. They noted that there is a perception that children have a higher incidence of spontaneous passage of larger stones than adults. The committee agreed that unlike the adult population where URS should be offered in the first instance and SWL considered if facilities allow quick stone clearance, for children and young people, both SWL and URS could be treatment options so allowing clinical flexibility.

### **Children and young people, ureteric stones, greater than 20 mm**

No evidence was identified and the committee agreed that currently these stones are treated on a case-by-case basis. They decided that they could not make a recommendation for this group.

### **Children and young people, renal stones, less than 10 mm**

No evidence was identified. The committee discussed current practice and agreed that URS or SWL should be considered in the first instance, and PCNL when other treatment has failed.

### **Children and young people, renal stones, 10 to 20 mm**

Very limited evidence from a single study showed a benefit of URS in terms of stone-free state, retreatment and significant residual stones when compared with SWL. Limited evidence from another single study showed benefits of PCNL in terms of stone-free state, retreatment rate and ancillary procedures when compared with SWL. The only evidence showing a benefit for SWL was for fewer minor adverse events, when SWL was compared with PCNL. Two non-randomised studies comparing URS and PCNL had inconclusive results. The committee agreed that clinical judgement should be used when deciding which treatment to use (URS, SWL or PCNL).

## **Children and young people, renal stones, greater than 20 mm**

Evidence from a single study showed a benefit of URS compared with PCNL in terms of length of stay and adverse events, but a benefit of PCNL in terms of stone-free state and retreatment rate. Evidence from 2 small studies showed a benefit of tubeless PCNL compared with standard PCNL in terms of length of stay, ancillary procedures and minor adverse events, but a benefit of standard PCNL in terms of retreatment. One non-randomised study showed a benefit of PCNL compared with SWL for stone-free state and retreatment, but a benefit of SWL for length of stay.

The committee agreed that PCNL may be effective, but carries more risks than URS. They decided that either URS or PCNL could be considered, and that SWL should not be ruled out.

## **Children and young people, renal stones, staghorn**

No evidence was identified. The committee agreed that staghorn stones in children would be treated in the same way as stones greater than 20 mm.

## **How the recommendations might affect practice**

Changes in practice are likely for adults with ureteric stones smaller than 10 mm because SWL is recommended, whereas currently URS is more frequently used. Economic analysis showed there will be a saving from using SWL over URS, although this may be more longer term because of short-term implementation costs required. Having good referral systems may mean that additional lithotripters are not needed. Alternatively, more investment in mobile or fixed lithotripters could be an option, or networks of mobile or fixed-site lithotripters allowing patients timely access to treatment. However, more staff may be needed to undertake SWL (for example, ultrasonographers) to meet the additional demand. Additional training to maximise the effectiveness of lithotripsy may also be needed. Increases in staffing can provide benefits to other areas of the NHS because it is likely that not all their time will be spent treating renal and ureteric stones.

In adults with ureteric stones of 10 to 20 mm, URS tends to be used, so recommendations to consider SWL could lead to a change in practice, with potential longer-term savings, depending on uptake.

In adults with renal stones of 10 to 20 mm, PCNL tends to be used, so recommendations to

consider URS or SWL as first line could lead to a change in practice, with likely savings, depending on uptake.

Other recommendations for adults reflect current practice. In children, multiple treatment options have been recommended to allow for clinical judgement, and therefore a change in practice is unlikely.

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## Timing of surgical treatment for ureteric stones

### [Recommendation 1.5.4](#)

#### Why the committee made the recommendation

Evidence showed a benefit of early intervention (within 48 hours) in terms of stone removal, repeated or ancillary procedures, and stent insertion. This could lead to substantial cost savings on a population level from stents and further treatment avoided. The committee agreed that ureteric stones can be extremely painful and if left untreated can lead to a loss of kidney function. Surgical treatment should be offered within 48 hours of diagnosis or readmission, to people presenting with ureteric stones and renal colic, if the pain is ongoing and not tolerated or the stone is unlikely to pass.

Although the evidence was from people with stones less than 20 mm, the committee agreed that ureteric stones of all sizes should be treated within this timeframe. There was no evidence for people with renal stones, and the committee considered that the timing of treatment for these stones should be prioritised according to the nature and severity of symptoms. There was also no evidence found for children and young people, and so the committee agreed that the recommendations should only apply to adults.

#### How the recommendation might affect practice

Current practice is to aim to treat ureteric stones in adults with an elective surgical procedure within 4 to 6 weeks, although practice can vary and is influenced by the availability of services. People are likely to have a stent inserted while waiting for surgery.

To implement these recommendations for URS, services would need to be reconfigured to

allocate more theatre time for emergency surgery. More equipment would also be needed for SWL, such as more responsive networks of mobile lithotripters, more fixed-site machines or better organised referral systems. Early intervention is likely to lead to substantial savings by avoiding the need for further treatments and the use of stents. These savings are likely to outweigh the implementation costs, and therefore this recommendation is not expected to have a cost impact overall.

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## Medical expulsive therapy as adjunctive to shockwave lithotripsy

[Recommendation 1.5.5](#)

### Why the committee made the recommendation

Evidence showed a benefit in terms of stone passage when alpha blockers were used as adjunctive therapy for adults having SWL for small distal or proximal ureteric stones (less than 10 mm). There was no difference in adverse events. The evidence focused on distal or proximal ureteric stones but the committee agreed that alpha blockers could be considered as adjunctive therapy to SWL for adults with small ureteric stones in any location. There was no evidence for mid-ureteric stones less than 10 mm; however, the committee agreed that this is a small group of people and usual clinical practice often involves waiting to see if the stone progresses to the distal ureter. There was not enough evidence for the committee to make a recommendation for adjunctive therapy for other interventions or for larger ureteric stones of 10 to 20 mm.

Evidence showed that the use of alpha blockers in conjunction with URS improved stone passage and some adults with small distal ureteric stones (less than 10 mm) and proximal ureteric stones (10 to 20 mm) experienced reduced pain. The committee agreed that this is not usual practice and also noted that the evidence was based on single studies. They agreed that further research on the use of alpha blockers, particularly tamsulosin, as adjunctive therapy to URS for any stone less than 20 mm would be beneficial to inform future practice, so decided to make a [recommendation for research on alpha blockers and ureteroscopy](#).

## How the recommendation might affect practice

Alpha blockers are not widely used as an adjunct to SWL for ureteric stones so this will represent a change in practice. The small cost of the alpha blockers is likely to be outweighed by savings related to improved stone clearance (reduced use of surgical interventions).

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## Stenting after ureteroscopy

[Recommendation 1.6.1](#)

### Why the committee made the recommendation

No evidence was found for the use of stents after SWL or PCNL, or for people with renal stones, or for children and young people.

Evidence showed that there was no benefit of routine stenting after URS for adults with ureteric stones less than 20 mm. Stents were associated with a number of adverse symptoms (dysuria, haematuria, irritative symptoms, frequency and urgency). People with a stent also had more abdominal and bladder pain, which the committee agreed were likely to be stent related. The committee agreed that because there was no benefit of stents, and they cause adverse events that negatively affect quality of life, stents should not be routinely offered to adults who have had URS for ureteric stones less than 20 mm. There may be instances when stents might be considered (such as more treatment anticipated, evidence of infection or obstruction, or a solitary kidney).

There was no evidence for stones larger than 20 mm. The committee agreed that this is a small group and the surgical treatment used varies. They noted that the decision to use a stent would be based on clinical judgement and so agreed not to make a recommendation for this group.

### How the recommendation might affect practice

Currently around 70% of people overall receive a stent after URS and many of these are being used to avoid future problems that are unlikely to occur. Stents may still be needed in some cases, for example, when further treatment is anticipated, or there is evidence of

infection or obstruction, a solitary kidney or for a Clavien–Dindo grade 3 complication. A few urologists currently advocate the routine placement of stents after all URS procedures. The recommendation is likely to mean that fewer people receive stents, which may be cost saving.

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## Metabolic testing

[Recommendations 1.7.1 to 1.7.3](#)

### Why the committee made the recommendations

Stone analysis and blood testing (serum calcium) allows the diagnosis of treatable conditions such as cystinuria, uric acid stones and primary hyperparathyroidism. Urine testing allows for the identification of metabolic abnormalities that can be treated, and so reduces the risk of future stones.

Evidence showed that there is effective treatment for hypercalciuria and hypocitraturia, and the committee noted that these conditions would be diagnosed with a 24-hour urine test. This suggests that understanding underlying metabolic diseases can lead to prevention of stone recurrence. However, no evidence for 24-hour urine testing was identified, so the committee agreed that they could not make a practice recommendation. They agreed to make a [recommendation for research on the clinical and cost effectiveness of a full metabolic investigation](#) to inform future guidance.

No evidence was found on stone analysis or blood tests in people who have or have had renal or ureteric stones. It is not clear which tests are most useful and whether tests should be offered to all people with a stone or just those at high risk of stone recurrence. However, the committee also considered the high prevalence of primary hyperparathyroidism in people with renal stones and noted that this could be identified with serum calcium testing, which is an inexpensive test. Therefore, the committee agreed that serum calcium should be measured for adults and stone analysis considered.

The committee agreed that current practice for children and young people is variable. All paediatric patients should have a metabolic assessment. The nature of this assessment varies nationally. Referral to a paediatric nephrologist or urologist with expertise in testing for metabolic conditions should be considered.

## How the recommendations might affect practice

Current practice is varied with a full range of metabolic tests being done in some areas and fewer tests in others. Therefore, the recommendations may mean a change in practice for some providers. However, the committee agreed that existing centres should have the resources to cope with an increased demand for stone analysis, which is relatively easy to do and is not urgent.

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## Frequency of follow-up imaging

### Why the committee made the recommendation for research

No evidence was found on the optimum frequency of imaging in people who have or have had renal or ureteric stones. The committee agreed that there is variation in current practice, with frequency often depending on factors such as whether the person has had 1 stone or recurrent stones. The committee was not able to make a recommendation for practice because their experience differed, but they did agree to make a [recommendation for research on the frequency of follow-up imaging](#) to inform future guidance.

Full details of the evidence and the committee's discussion are in [evidence review J: imaging for follow-up](#).

## Preventing recurrence

[Recommendations 1.8.1 to 1.8.5](#)

### Why the committee made the recommendations

#### Diet and lifestyle advice

Some evidence showed a benefit of a high water intake in reducing stone recurrence in adults. Limited evidence from a single study in adults showed a benefit of lemon juice in terms of urine calcium and pH but no difference in urine oxalate. Lemon juice is high in citrate leading to higher concentrations of citrate in urine. This may stop calcium from



binding to other stone constituents and so prevent stone formation and recurrence. The committee agreed to recommend a high water intake and the addition of lemon juice to water. Evidence showed a benefit of avoiding carbonated drinks in terms of stone recurrence, and so the committee agreed to recommend that these should be avoided.

Evidence on diet was mixed but the committee agreed that a normal calcium intake and a low salt intake may help to prevent stone recurrence. Evidence on avoiding a high protein diet was inconclusive, but the committee acknowledged that this is the advice currently given.

### **Potassium citrate**

Evidence showed that potassium citrate could reduce the recurrence of calcium oxalate and calcium oxalate/calcium phosphate stones in adults. However, there were adverse events associated with the use of potassium citrate and the committee agreed that there may be concerns about high levels of potassium in the blood (hyperkalaemia) in some groups. Despite this, the committee agreed that the benefits in terms of stones avoided are likely to outweigh any harms. Potassium citrate is currently used in UK practice and so the committee agreed it could be considered to prevent stone recurrence in adults with calcium oxalate stones.

Limited evidence in children showed that potassium citrate reduced stone recurrence after PCNL and SWL. There was no information on adverse events or on the type of stone or results of urine testing. The committee noted that in UK practice, potassium citrate is used for children based on the levels of calcium or citrate in urine. They agreed that it could be considered for children with recurrence of calcium oxalate stones and with hypercalciuria or hypocitraturia.

### **Thiazides**

Limited evidence showed that thiazides reduced stone recurrence in adults with high levels of calcium in urine (hypercalciuria) compared with no intervention. There was no benefit for adults with normal levels of urinary calcium, and evidence was mixed when the biochemical abnormality was mixed or not defined. The committee agreed that thiazides tend to be well tolerated but should only be used after salt has been restricted. They agreed that thiazides could be considered for adults with hypercalciuria and recurrent calcium oxalate stones, but only after reducing salt intake to recommended levels.

There was not enough evidence for the committee to make recommendations on allopurinol or combined therapy of allopurinol and thiazides. Although limited evidence suggested a potential benefit of magnesium, the committee knew from their experience that magnesium may cause adverse effects. The committee agreed that the limited evidence and potential for adverse events did not justify a recommendation.

Limited evidence from a single study of thiazides compared with placebo in people who had had previous SWL showed some benefit of thiazides in reducing the need for further SWL and for stone growth. The committee agreed that this is not usual practice and that further research would be beneficial. The committee agreed to make a [recommendation for research on preventative treatment following SWL](#).

## How the recommendations might affect practice

### Diet

The recommendations on diet broadly reflect current practice. They emphasise the importance of dietary advice in preventing further stone episodes. Dietary advice should be given in conjunction with lifestyle advice.

### Potassium citrate and thiazides

The committee considered the impact the recommendations would have on practice, including metabolic laboratory testing. Identifying stone composition or metabolic abnormalities would be a prerequisite to the recommendations and this would have a cost as well as potential service impact.

Recommending the interventions also has a monitoring impact. There is variation in current practice in terms of the use of thiazides and potassium citrate for people with renal or ureteric stones.

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## Context

Renal and ureteric stones usually present as an acute episode with severe pain, although some stones are picked up incidentally during imaging or may present as a history of infection. The initial diagnosis is made by taking a clinical history and examination and carrying out imaging; initial management is with painkillers and treatment of any infection.

Ongoing treatment of renal and ureteric stones depends on the site of the stone and size of the stone (less than 10 mm, 10 to 20 mm, greater than 20 mm; staghorn stones). Options for treatment range from observation with pain relief to surgical intervention. Open surgery is performed very infrequently; most surgical stone management is minimally invasive and the interventions include shockwave lithotripsy (SWL), ureteroscopy (URS) and percutaneous stone removal (surgery). As well as the site and size of the stone, treatment also depends on local facilities and expertise. Most centres have access to SWL, but many use a mobile machine on a sessional basis rather than a fixed-site machine, which has easier access during the working week. The use of a mobile machine may affect options for emergency treatment, but may also add to waiting times for non-emergency treatment.

Although URS for renal and ureteric stones is increasing (there has been a 49% increase from 12,062 treatments in 2009/10, to 18,066 in 2014/15 [Hospital Episode Statistics data]), there is a trend towards day-case/ambulatory care, with this increasing by 10% to 31,000 cases a year between 2010 and 2015. The total number of bed-days used for renal stone disease has fallen by 15% since 2009/10. However, waiting times for treatment are increasing and this means that patient satisfaction is likely to be lower.

Because the incidence of renal and ureteric stones and the rate of intervention are increasing, there is a need to reduce recurrences through patient education and lifestyle changes. Assessing dietary factors and changing lifestyle have been shown to reduce the number of episodes in people with renal stone disease.

Adults, children and young people using services, their families and carers, and the public will be able to use the guideline to find out more about what NICE recommends, and help them make decisions. These recommendations apply to all settings in which NHS-commissioned care is provided.

# Finding more information and committee details

To find NICE guidance on related topics, including guidance in development, see the [NICE topic page on renal stones](#).

For full details of the evidence and the guideline committee's discussions, see the [evidence reviews](#). You can also find information about [how the guideline was developed](#), including details of the committee.

NICE has produced [tools and resources to help you put this guideline into practice](#). For general help and advice on putting our guidelines into practice, see [resources to help you put NICE guidance into practice](#).

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