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FIGURE 1
CT KUB and left-sided calyceal calculi

How do patients with renal stones present?

NEPHROLITHIASIS, OR RENAL STONE DISEASE, IS COMMON AND THE INCIDENCE IS INCREASING globally.[1,2] In the UK, the lifetime risk is estimated to be 8-10%.

Historically there has been a three-fold higher incidence of renal stones in men compared with women; however, this gender gap appears to be closing.[2,3] The age of onset of a first stone has also changed in recent years with more people symptomatic at a younger age, though calculi remain relatively uncommon before the age of 20 years.

It is estimated that as many as 50% of stone formers will have at least one more symptomatic stone in their lifetime, with numerous stone recurrences seen in approximately 10%.[4]

In the UK, the majority of stones are calcium based, and associated with oxalate or phosphate or both. A minority of patients will have an underlying identifiable metabolic disorder or aetiology.[1] However, even in the group of 'idiopathic' stone formers, there are known common factors that predispose to calculus precipitation such as high salt intake, low fluid intake, and White ethnicity. Those with metabolic syndrome are also at increased risk of stone formation.[3]

How can risk of recurrence be reduced?

On a population level, the increase in stone incidence, erosion of gender disparity, and younger age of onset is likely to reflect obesity and a Western diet with a high intake of animal protein and salt.[2]

Renal stones can be classified in a variety of ways, see table 1, p18. The size and anatomical location are relevant to the acute management of renal colic. These two factors dictate likelihood of spontaneous stone passage or need for acute intervention.[5] The aetiology of stone formation has implications for chronic disease management in terms of reducing the likelihood of stone recurrence, see table 2, p18.

'50% of stone formers will have at least one more symptomatic stone in their lifetime'

When should patients be referred?

PRESENTATION

The classical presentation of a kidney stone is with acute renal or, more accurately, ureteric colic. The patient will present to primary care or the emergency department with acute severe unilateral loin or flank pain. Typically there are acute spasms of severe pain. Radiation of the pain to the groin, and then testicles in men and labia in women, occurs as a stone migrates caudally.[6] Nausea, vomiting and visible haematuria can accompany the pain.

The constellation of renal angle »

tenderness and haematuria on urinalysis, accompanying an acute onset of loin-to-groin colicky pain has a reported sensitivity in excess of 80% and specificity approaching 100% for renal stone disease.[6,7] It is important to remember that absence of non-visible haematuria on urinalysis does not exclude a diagnosis of renal stone disease.

The list of potential differential diagnoses of abdominal pain with nausea and vomiting is of course substantial.[6] Patients with peritonitis typically lie still as movement exacerbates their pain, while retroperitoneal pathology is classically associated with the 'restless rollers'. Testicular pathology is often associated with tenderness, but this sign is not present if the testicular symptoms are related to ureteric colic. Where there is diagnostic uncertainty as to the aetiology of signs and symptoms, haemorrhage from abdominal aortic aneurysm should be among the differential diagnoses in at-risk populations and prompt urgent referral.

Table 1

Classification of renal stones

Stone size	Up to 5 mm 5-10 mm 10-20 mm > 20 mm
Anatomical location	Upper, middle or lower calyx Renal pelvis Upper, middle or distal ureter Urinary bladder
Radiological appearance	Radiopaque Poor radiopacity Radiolucent
Aetiology	Idiopathic stones Infection-associated stones Genetic defects Drug-associated stones

Table 2

Stone composition based on aetiology

Aetiology	Stone composition
Idiopathic	Calcium oxalate Calcium phosphate Uric acid
Infection	Magnesium ammonium phosphate Carbonate apatite Ammonium urate
Genetic defect	Cystine stones Xanthine stones 2,8-dihydroxyadenine stones
Drug associated	Triamterene Indinavir Atazanavir Loop diuretics Theophyllines Sulfonamides (i.e. sulfadiazine) Ciprofloxacin Ceftriaxone Acetazolamide Vitamins D and C Topiramate Orlistat Laxatives

'Radiation of the pain to the groin occurs as a stone migrates caudally'

Loin pain and haematuria can have a non-calculus aetiology. Upper urinary tract infection, clot, tumour, or sloughed renal papilla may present in a similar manner.[6] Such pathology will be present in only a minority of cases and the distinction can be made in secondary care where additional investigations are available. Identification in primary care of the correct anatomical site of pathology will ensure direction to the appropriate service.

Increasingly asymptomatic renal calculi are detected incidentally on imaging, (typically CT scanning), for another reason. Often these are very tiny flecks of calcification, perhaps 2 or 3 mm in diameter. The patient typically has no personal or family history of stone disease and examination (including urinalysis) is unremarkable. These patients should be given the same advice about reducing recurrence as symptomatic stone formers (see p20). In addition, they need to be informed about potential complications as they may develop symptomatic disease. Routine re-evaluation by interval scanning is not required in the absence of symptoms.

INVESTIGATION

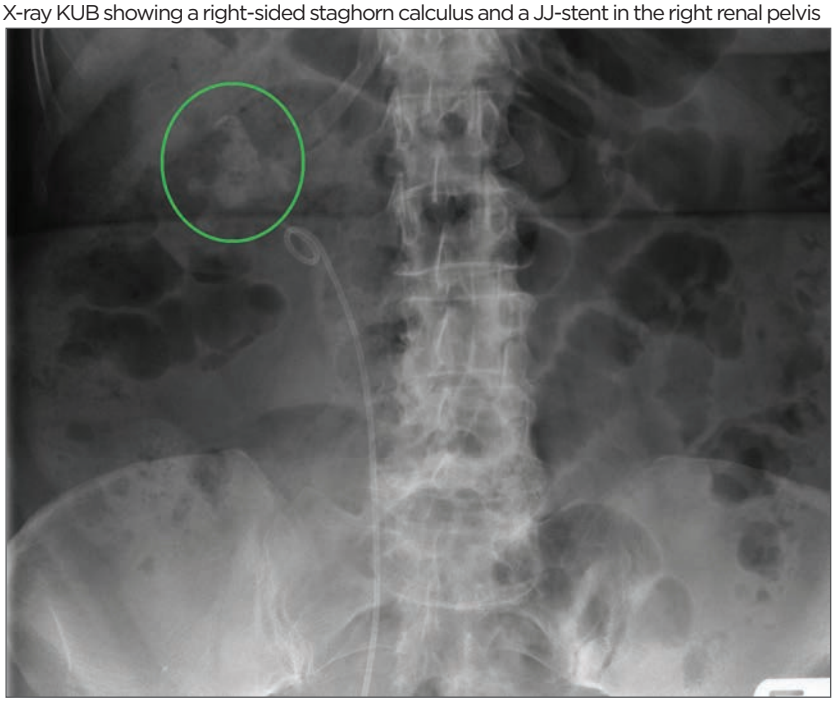
A minimum set of investigations required for all patients at first presentation of symptomatic renal stone disease are listed in table 3, opposite.[8] These relate to:

- Confirmation of diagnosis and quantification of stone burden
- Management of the acute presentation. (Is there renal impairment or infection?)
- Exclusion of common underlying metabolic abnormalities. (Is there hypercalcaemia or hyperuricaemia?)

Stone analysis should be performed whenever possible. Biochemical determination of stone composition can guide subsequent therapy to reduce recurrence risk. During an acute episode the patient should be asked to pass urine through a sieve and retain the stone or gravel for biochemical analysis if possible.[9]

Stones can be detected by a variety

FIGURE 2
X-ray KUB showing a right-sided staghorn calculus and a JJ-stent in the right renal pelvis



of imaging techniques. The gold standard is a non-contrast CT of kidneys, ureters and bladder (KUB), which can identify > 99% of stones.[8]

CT KUB should be the primary mode of imaging for all patients with colic unless contraindicated, see figure 1, p17. In such instances, or if a CT KUB is not available an ultrasound KUB is an alternative. This has advantages in terms of radiation exposure and cost, but is limited in sensitivity, particularly for ureteric stones. Once diagnosed, a plain film KUB can be used for follow-up of radiopaque stones.

'CT KUB should be the primary mode of imaging for all patients with colic'

Additional testing is indicated for those with recurrent disease or when there are multiple stones on imaging at presentation. Other clinical features that suggest there may be an underlying abnormality are outlined in table 4, below.

Two 24-hour urinary collections are required for a complete metabolic screen,[3] (urinary volume, total excretion of sodium, calcium, phosphate, oxalate, and citrate, urinary pH value and presence of cystine are of particular interest), but analysis of results will be undertaken in secondary care.

ACUTE MANAGEMENT

Patients with acute ureteric colic may be safely managed in primary care. However, referral for emergency care must be considered for certain patients who are at significant risk of complications from a renal stone. This can be gauged by the medical history, current clinical status, and response to initial treatment. The clinical features necessitating emergency referral are outlined in table 5, right.[9]

For most patients diclofenac is a reasonable first choice of analgesia, e.g. 50-100 mg rectally, or 75 mg IM. Opioid medication can worsen nausea and be less effective, but should be used (e.g. 2.5 mg SC diamorphine) if there is a contraindication to NSAIDs.

A combination of diclofenac, paracetamol, and/or codeine regularly can provide adequate pain control for many patients.[9] Failure of this analgesic combination should prompt consideration of secondary care support.

Parenteral antiemetic therapy may be required initially, cyclizine or metoclopramide are common choices, and can then be switched to oral administration.[9]

Referral to hospital for fast-track imaging (CT KUB) is required, and should be performed within seven days. Clearly worsening symptoms or development of infection will require acceleration of investigation and emergency management. Patients should be advised to seek medical attention if they develop a fever, are unable to tolerate fluids, or have recurrence of severe pain.[9]

If a ureteric stone < 5 mm in diameter is identified, the expectation is that this will pass without intervention.[5] It is reasonable to continue medical management for up to four weeks. Alpha-blockade (e.g. tamsulosin 400 µg daily) was previously advocated to reduce transit time and symptoms, however, evidence from a large randomised controlled trial in 2015 did not support its use in reducing the need for subsequent intervention.[10] A KUB plain film should be requested to ensure the stone has passed. If it has not, urology assessment is required.

Initially medical management as outlined above is still useful for stones between 5 and 10 mm in diameter, but urology input is more likely to be necessary as up to 50% of these may require intervention. »

Table 3

Investigations required for all patients presenting with renal colic

Urine	Blood	Imaging
Urinalysis	**Renal function**	**CT KUB***
— Blood		
— Leukocytes	**Electrolytes**	
— Nitrites	— Calcium	
	— Phosphate	
Culture	— Bicarbonate	
	Uric acid	

*CT kidney, ureters, and bladder (unless contraindicated, in which case consider ultrasound scan)

Table 4

Features suggestive of a metabolic or anatomical abnormality

Clinical presentation	Young age of onset	Early recurrence (especially < 1 year)
Biochemical analysis	Hypercalcaemia	Metabolic acidosis (low bicarbonate)
Stone analysis	Non-calcium	

Table 5

Clinical features necessitating emergency referral to secondary care

Medical history	Kidney transplant	
	Single functioning kidney	
	Pregnancy	
	Chronic kidney disease	Stages 3-5
Clinical status	Signs of infection	Unwell, febrile Urinalysis: leukocytes ± nitrites
	Passing minimal or no urine	
	Diagnostic uncertainty	e.g. need exclusion of aortic aneurysm
	Poor social support	
Response to treatment	Unable to maintain oral intake	
	Unable to tolerate medication	
	Poor control of symptoms	

key points

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Nephrolithiasis, or renal stone disease, is common and the incidence is increasing globally. In the UK the lifetime risk is estimated to be 8-10%. On a population level, the increase in stone incidence, erosion of gender disparity, and younger age of onset is likely to reflect increasing prevalence of obesity and a Western diet with a high intake of animal protein and salt.

Stones can be detected by a variety of imaging techniques. The gold standard is a non-contrast CT of kidneys, ureters and bladder (CT KUB) which can identify > 99% of stones. CT KUB should be the primary mode of imaging for all patients with colic unless contraindicated. In such instances, or if a CT KUB is not available an ultrasound KUB is an alternative. This has advantages in terms of radiation exposure and cost, but is limited in sensitivity, particularly for ureteric stones. Once diagnosed, a plain film KUB can be used for follow-up of radiopaque stones.

For most patients diclofenac is a reasonable first choice of analgesia, e.g. 50-100 mg rectally, or 75 mg IM. Opioid medication can worsen nausea and be less effective, but should be used (e.g. 2.5 mg SC diamorphine) if there is a contraindication to NSAIDs. A combination of diclofenac, paracetamol, and/or codeine regularly can provide adequate pain control for many patients. Failure of this analgesic combination should prompt consideration of secondary care support.

If a ureteric stone < 5 mm in diameter is identified, the expectation is that this will pass without intervention. Initially medical management is still useful for stones between 5 and 10 mm in diameter, but urology input is more likely to be necessary as up to 50% of these may require intervention. Stones that are > 10 mm in diameter should be discussed with the urology service as they are unlikely to pass spontaneously.

The most important advice for all patients, regardless of stone composition, is a copious fluid intake, a minimum of 2 to 2.5 L/day. Patients should avoid a high-salt intake and maintain a healthy weight. Specific dietary measures are only required when there are recurrent calculi.

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Stones > 10 mm in diameter should be discussed with the urology service as they are unlikely to pass spontaneously.[5]

REDUCING RECURRENCE

Stone recurrence is common and should be anticipated in patients with underlying genetic or metabolic abnormalities, those with staghorn calculi (see figure 2, p18), and individuals who have previously required intervention for stone disease. These patients are typically followed up (at least initially) in secondary care.

'Patients should be advised to drink enough so that their urine looks like a gin and tonic not a pint of lager'

However, the most important advice for all patients, regardless of stone composition, is a copious fluid intake.[11,12,13] Some patients may find it helpful to have a numerical value attached to the actual volume they should drink, in which case they should be advised to drink a minimum of 2 to 2.5 litres per day.[3]

Of course, the appropriate volume is variable and will depend also on insensible fluid losses. The goal is to produce dilute urine. A simple, useful and accurate marker of having achieved this is the colour of the urine. Patients should be advised to drink enough so that their urine looks clear in colour, (like a gin and tonic and not a pint of lager!).

Recurrent stone formers should be advised to drink a glass of water when going to bed at night, ideally so they have to get up at least once to pass urine, at which stage they should have another glass of water. This minimises the risks associated with several hours of concentrated urine overnight.

Patients should avoid a high-salt intake and maintain a healthy weight.[3] Specific dietary measures are only required when there are recurrent calculi. Advice should be individualised based on 24-hour metabolic stone profile with follow-up collections to ensure correction of abnormalities.[3] Pharmacological therapy is reserved for a minority of cases and will be initiated by specialists (in urology or nephrology). The following may be prescribed depending on the underlying abnormality:[3,13] thiazide diuretics, calcium supplementation with meals, allopurinol, potassium citrate, D-penicillamine, captopril.

CONCLUSION

Only a minority of patients with renal stone disease will have a primary metabolic or anatomical abnormality, but despite this recurrent stone formation is common.

There are simple measures that can greatly reduce the risk of stone formation, and the associated morbidity. Successful management is a partnership between the patient and the primary care team, with specialist input required occasionally for high-risk patients or those with recurrent or difficult to manage disease.

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Useful information

British Association of Urological Surgeons
www.baus.org.uk/patients/conditions/6/kidney_stones

Edinburgh Renal Unit
www.edren.org/pages/edreninfo/kidney-stones.php

Patient.info
http://patient.info/doctor/urinary-tract-stones-urolithiasis