



Prompt recognition and treatment crucial in pyelonephritis

Elhaim R, O'Rourke D, Hill C. Prompt recognition and treatment crucial in pyelonephritis.
Practitioner November/December 2022;266(1863):25-27

Abstract

Acute pyelonephritis is a bacterial infection of the kidney parenchyma that can cause organ damage and be life-threatening. It is associated with systemic symptoms and flank pain which are not usually present in lower urinary tract infections. Patients may also have lower urinary tract symptoms. The severity of the illness can vary from relatively mild to patients presenting with septic shock. Initial assessment should always include checking heart rate and BP to determine whether the patient is haemodynamically unstable. A midstream urine sample or catheter specimen of urine should be obtained before initiating antibiotic therapy. However, if pyelonephritis is suspected empirical treatment should not be delayed while waiting for the urine culture result. Early recognition and aggressive management of sepsis is required to prevent serious complications. Patients should be urgently referred to the emergency department if they are unwell and showing signs of sepsis (hypotension, tachycardia, hypothermia or pyrexia, signs of systemic illness such as rigors). Patients at higher risk of severe disease (elderly comorbid patients or those in other risk groups) may also warrant urgent referral.

Dr Razan Elhaim
MB BCh BAO
GPST1,
Belfast Health and Social Care Trust,
Belfast, UK

Dr Declan O'Rourke
MB BCh BAO FRCP FRCPath
Consultant Histopathologist,
Belfast Health and Social Care Trust and Honorary Professor of Pathology,
University of Ulster,
Belfast, UK

Dr Christopher Hill
MD FRCP
Consultant Nephrologist,
Belfast Health and Social Care Trust,
Belfast, UK



Practitioner
Medical Publishing Ltd

Prompt recognition and treatment crucial in pyelonephritis

AUTHORS

Dr Razan Elnaim

MB BCh BAO
GPST1, Belfast Health and Social Care Trust, Belfast, UK

Dr Declan O'Rourke

MB BCh BAO FRCP
FRCPath
Consultant
Histopathologist,
Belfast Health and Social Care Trust and Honorary Professor of Pathology, University of Ulster, Belfast, UK

Dr Christopher Hill

MD FRCP
Consultant Nephrologist, Belfast Health and Social Care Trust, Belfast, UK

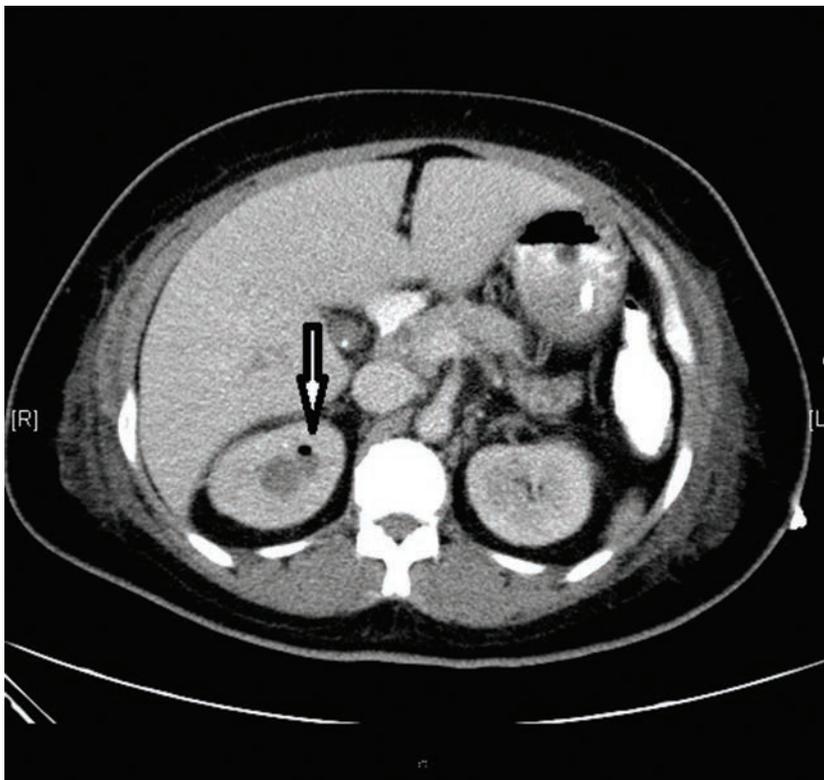


FIGURE 1
CT abdomen showing acute emphysematous pyelonephritis (gas formation in right kidney identified by arrow)



ACUTE PYELONEPHRITIS IS A BACTERIAL INFECTION OF THE KIDNEY PARENCHYMA THAT CAN CAUSE ORGAN

damage and be life-threatening. Acute pyelonephritis has an estimated incidence of 1 in 830 in England. It is six times more common in females than males.¹ It is associated with systemic symptoms and flank pain which are not usually present in lower urinary tract infections (UTIs).

Early recognition and aggressive management of sepsis is required to prevent serious complications.

Bacteria usually gain entry to the urinary tract from the perineal region. Infection of the bladder results in symptoms such as dysuria, frequency, and urgency but does not usually result in systemic symptoms. If there is ascending infection into the kidney it is defined as pyelonephritis.

Haematogenous spread of infection to the kidney can occur occasionally (e.g. septic emboli in endocarditis) but is much less common. Risk factors for pyelonephritis are listed in table 1, p26.

COMMON SYMPTOMS AND SIGNS

Patients with acute pyelonephritis classically present with the following:

- Pyrexia - temperatures often exceed 38.5°C
- Costovertebral (renal) angle pain and tenderness
- Anorexia, nausea, and vomiting

Patients may also have lower urinary tract symptoms such as frequency, urgency and dysuria. The severity of the illness can vary from relatively mild to patients presenting with septic shock. Initial assessment should always include checking heart rate and blood pressure to determine whether the patient is haemodynamically unstable.

The classic signs and symptoms observed in adults are often absent in children, particularly neonates and infants. In children, two years of age and younger, the most common symptoms of UTI are failure to thrive, feeding difficulty, fever, and vomiting. When fever is present, pyelonephritis should be included in the differential diagnosis.

Elderly patients may present with typical manifestations of pyelonephritis

What are the symptoms and signs?

How should diagnosis be confirmed?

When should patients be referred?

or with non-specific findings such as acute delirium (particularly in those with underlying cognitive impairment).

DIAGNOSIS

Initial diagnosis is based on history and examination. Dipstick urinalysis can be helpful if positive for leucocytes and/or nitrites. It is important to note that some bacteria do not cause nitrite release (e.g. Enterococcus or Pseudomonas species) so it has lower sensitivity but good specificity as a test. Dipstick urinalysis may be less useful in certain patient groups such as those with an indwelling catheter or those aged over 65 years. In these circumstances, a working diagnosis should be made on the basis of history and examination findings. Common causative organisms for pyelonephritis are shown in table 2, p26.

A midstream urine sample (MSSU) or catheter specimen of urine (CSU) should be obtained before initiating antibiotic therapy. However, if pyelonephritis is suspected empirical treatment should not be delayed while waiting for the urine culture result. It is often difficult to

SPECIAL REPORT

PYELONEPHRITIS

obtain an MSSU from infants so a clean catch specimen is an acceptable alternative.

Imaging is not usually required unless:

- The patient is severely ill
- There is a concern about renal tract obstruction
- There is evidence of acute kidney injury
- The patient has failed to respond despite 48 hours of appropriate antimicrobial therapy

Renal tract ultrasound is useful as an initial step to rule out hydronephrosis. However, CT scanning is the optimal imaging choice for detecting evidence of complications of severe pyelonephritis.²

MANAGEMENT

Patients who are unwell and showing signs of sepsis (hypotension, tachycardia, hypothermia or pyrexia, signs of systemic illness such as rigors) should be urgently referred to the emergency department. Patients who are at higher risk of severe disease (elderly comorbid patients or patients in one of the categories listed in table 1, below) may also warrant urgent referral.

Empirical antibiotic therapy should be based on local formularies and

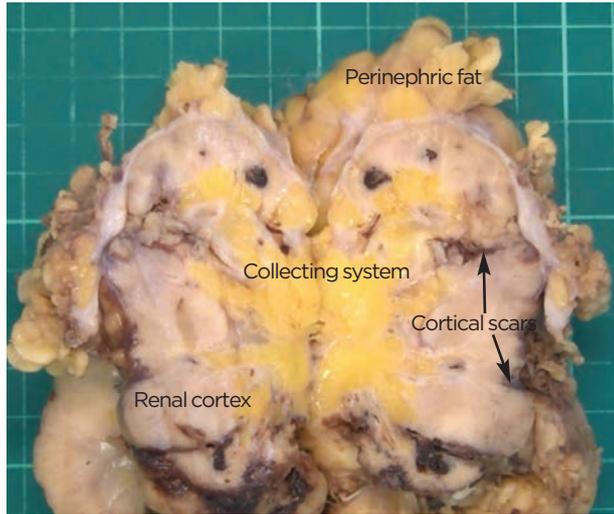


FIGURE 2
Chronic pyelonephritis. Recurrent episodes of pyelonephritis, especially in childhood, result in cortical scarring

microbiological guidance. In general, antibiotics such as co-amoxiclav, cefalexin or ciprofloxacin are good oral agents to use if the patient does not require hospitalisation.⁴ If the patient needs to be admitted to hospital intravenous antibiotics are usually indicated. Most treatment regimens will continue for 7 to 10 days.

Once antibiotic sensitivities are known,

antimicrobial therapy can be rationalised if required so it is very important to check the MSSU result. Ideally, patients should be reviewed after 48 hours of initial treatment or earlier if their condition deteriorates. If there is no evidence of improvement at 48 hours, they may require referral to the emergency department.

A negative urine culture result may reflect a number of factors including prior antibiotic therapy or poor sampling technique but it should always prompt a reassessment to ensure there is no alternative diagnosis.

Table 1

Risk factors for pyelonephritis²

Female gender	<ul style="list-style-type: none"> ● Shorter anatomical distance from skin to bladder increases likelihood of bacterial ingress ● Hormonal changes post-menopause may also predispose to easier colonisation and infection of lower urinary tract
Immunosuppression	<ul style="list-style-type: none"> ● Solid organ transplant recipients ● Cancer patients receiving chemotherapy ● Patients with autoimmune conditions receiving oral immunosuppression or biologic therapies ● Other acquired immunodeficiency states e.g. HIV infection
Pregnancy	<ul style="list-style-type: none"> ● Physiological dilatation of the ureters during pregnancy may predispose to urine reflux from the bladder
Reflux nephropathy	<ul style="list-style-type: none"> ● Abnormal angle of insertion of the ureters into the bladder wall results in varying degrees of reflux
Urinary diversions	<ul style="list-style-type: none"> ● Ileal conduit ● Clam ileocystoplasty ● Neo-bladders (e.g. Mitrofanoff)
Diabetes mellitus	<ul style="list-style-type: none"> ● Glycosuria increases the likelihood of bacterial growth
Incomplete bladder emptying	<ul style="list-style-type: none"> ● Benign prostatic hypertrophy ● Neurogenic bladder

Special cases

Patients with indwelling catheters may always have positive urine cultures due to the development of a biofilm on the catheter's interior surface. CSU samples should only be sent if patients have symptoms and/or signs in keeping with a likely urinary infection. Indwelling catheters may also need to be changed if pyelonephritis is confirmed to reduce the risk of early recurrence or treatment failure.

Patients who are pregnant may need to be assessed at their maternity unit as

Table 2

Common causative organisms⁵

Organism	Frequency
<i>Escherichia coli</i>	60-80%
<i>Klebsiella</i> species	20%
<i>Proteus mirabilis</i>	15%
<i>Pseudomonas</i> species	Rare
<i>Enterobacter</i> species	Rare
Gram-positive organisms	Rare

key points

SELECTED BY

Dr Jez Thompson
Former GP, Leeds, UK

Acute pyelonephritis is a bacterial infection of the kidney

parenchyma that can cause organ damage and be life-threatening. It is associated with systemic symptoms and flank pain which are not usually present in lower urinary tract infections (UTIs). Early recognition and aggressive management of sepsis is required to prevent serious complications. Patients may also have lower urinary tract symptoms such as frequency, urgency and dysuria. The severity of the illness can vary from relatively mild to patients presenting with septic shock. Initial assessment should always include checking heart rate and BP to determine whether the patient is haemodynamically unstable.

The classic signs and symptoms observed in adults are

often absent in children, particularly neonates and infants. In children, two years of age and younger, the most common symptoms of UTI are failure to thrive, feeding difficulty, fever, and vomiting. When fever is present, pyelonephritis should be included in the differential diagnosis. Elderly patients may present with typical manifestations of pyelonephritis or with non-specific findings such as acute delirium (particularly in those with underlying cognitive impairment).

A midstream urine sample (MSSU) or catheter specimen

of urine should be obtained before initiating antibiotic therapy. However, if pyelonephritis is suspected empirical treatment should not be delayed while waiting for the urine culture result. It is often difficult to obtain an MSSU from infants so a clean catch specimen is an alternative. Patients should be urgently referred to the emergency department if they are unwell and showing signs of sepsis (hypotension, tachycardia, hypothermia or pyrexia, signs of systemic illness such as rigors). Patients at higher risk of severe disease (elderly comorbid patients or patients in other risk groups) may also warrant urgent referral. Empirical antibiotic therapy should be based on local formularies and microbiological guidance.

Early complications include: acute kidney injury (more common in severe disease and in patients with pre-existing CKD); septic shock and multiorgan dysfunction; abscess formation either in the renal cortex or the perinephric space; emphysematous pyelonephritis; papillary necrosis. Late complications include: CKD which can occur in patients with multiple episodes of pyelonephritis associated with repeated acute kidney injury and xanthogranulomatous pyelonephritis (this is extremely rare and usually associated with chronic infection or obstruction).

Recurrent episodes of pyelonephritis, especially in

childhood, result in cortical scarring. Recurrent infections reduce the number of functioning nephrons which, in turn, causes hyperfiltration in the remaining glomeruli. Over time, this causes damage to the glomeruli and eventually glomerulosclerosis. As more glomeruli are damaged, the hyperfiltration injury to the remaining ones increases.

Table 3

Potential complications of pyelonephritis

Early complications

- Acute kidney injury (AKI) – this is more common in severe disease. AKI is also more common in patients with pre-existing chronic kidney disease (CKD)⁶
- Septic shock and multiorgan dysfunction
- Abscess formation either in the renal cortex or the perinephric space
- Emphysematous pyelonephritis – infection caused by gas forming organisms (see figure 1, p25). It is more common in patients with diabetes mellitus and requires treatment with prolonged courses of intravenous antibiotics
- Papillary necrosis – renal papillae can become so inflamed that they become necrotic and drop into the collecting system. In rare cases, they can cause ureteric obstruction

Late complications

- CKD can occur in patients with multiple episodes of pyelonephritis associated with repeated AKI
- In xanthogranulomatous pyelonephritis the renal parenchyma is replaced with cellular infiltrate of lipid-laden macrophages. This is extremely rare and usually associated with chronic infection or obstruction

pyelonephritis increases the risk of premature labour.

Immunocompromised patients may require longer courses of antibiotics and preferential use of directly bactericidal antibiotics such as beta-lactams, quinolones or aminoglycosides.

In polycystic kidney disease the cysts can become infected and the infection does not behave like typical pyelonephritis. These patients usually require longer courses of antibiotics which will penetrate the wall of the infected cyst.

Early and late complications are shown in table 3, above.

Chronic pyelonephritis

Recurrent episodes of pyelonephritis, especially in childhood, result in cortical scarring, see figure 2, p26.

Recurrent infections reduce the number of functioning nephrons which, in turn, causes hyperfiltration in the remaining glomeruli. Over time, this causes damage to the glomeruli and eventually glomerulosclerosis. As more glomeruli are damaged, the hyperfiltration injury to the remaining ones increases. In 2020, chronic pyelonephritis accounted for 5.3% of all patients commencing renal replacement therapy (dialysis or kidney transplantation) in the UK.⁷

CONCLUSION

Pyelonephritis is usually characterised by flank/renal angle pain, pyrexia, nausea and vomiting. Patients may or may not have lower urinary tract symptoms. It can be severe and result in life-threatening complications.

Early institution of appropriate

antimicrobial therapy reduces the risk of complications. Recurrent episodes of pyelonephritis can result in progressive chronic kidney disease.

Competing interests: None

REFERENCES

- 1 Chivima B. Pyelonephritis. *Nurs Stand* 2014;28(23):61
- 2 National Institute for Health and Care Excellence. Clinical Knowledge Summary: Acute pyelonephritis. NICE. 2021 <https://cks.nice.org.uk/topics/pyelonephritis-acute>
- 3 Efsthathiou SP, Pefanis AV, Tsioulos DI et al. Acute pyelonephritis in adults: prediction of mortality and failure of treatment. *Arch Intern Med* 2003;163(10):1206-12
- 4 National Institute for Health and Care Excellence. NG111. Pyelonephritis (acute): antimicrobial prescribing. NICE. London. 2018 www.nice.org.uk/guidance/ng111
- 5 Acute pyelonephritis. BMJ Best Practice. <https://bestpractice.bmj.com/topics/en-gb/3000111>
- 6 Graversen HV, Nørgaard M, Nitsch D, Christiansen CF. Preadmission kidney function and risk of acute kidney injury in patients hospitalized with acute pyelonephritis: a Danish population-based cohort study. *PLoS One* 2021;16(3):e0247687
- 7 UK Renal Registry (2022) UK Renal Registry 24th Annual Report – data to 31/12/2020, Bristol, UK <https://ukkidney.org/audit-research/annual-report>

Useful information

For patients
www.nhs.uk/conditions/urinary-tract-infections-utis

We welcome your feedback

If you would like to comment on this article or have a question for the authors, write to:
editor@thepractitioner.co.uk