

PRACTICE

RATIONAL TESTING

Investigation of suspected urinary tract infection in older people

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This series of occasional articles provides an update on the best use of key diagnostic tests in the initial investigation of common or important clinical presentations. The series advisers are Steve Atkin, professor of medicine, Weill Cornell Medical College Qatar; and Eric Kilpatrick, honorary professor, department of clinical biochemistry, Hull Royal Infirmary, Hull York Medical School. To suggest a topic for this series, please email us at practice@bmj.com.

An 84 year old woman, who lived in a residential home, was referred to the acute medical assessment unit with a two day history of increasing confusion of unclear cause. She was unable to provide a clear history, but her daughter mentioned that she was not usually confused. On examination, her temperature was 36.8°C, her heart rate was 67 beats per minute, and her blood pressure was 135/70 mm Hg. She looked dehydrated and was noted to be incontinent of dark, offensive smelling urine. Urinary tract infection was suspected.

What is the next investigation?

Suspected urinary tract infection is a common scenario when evaluating ill older adults. The diagnosis may be challenging, as patients are often unable to provide a history of acute urinary symptoms (for example, owing to delirium or dementia), and asymptomatic bacteriuria (see table 1⇓ for definitions) is common in older people. The prevalence of asymptomatic bacteriuria is so high in older people (up to 50% in older women living in long term care)¹ that it does not necessarily indicate acute illness and is not, on its own, an indication for treatment. Such diagnostic difficulties may lead to over-diagnosis, unnecessary antibiotic treatment, and delay in making the true diagnosis. A retrospective review of 265 case notes for patients diagnosed as having a urinary tract infection at the time of discharge from hospital found that 43% of patients had no evidence of actually having had a urinary tract infection.²

On the basis of prospective cohort studies, the Health Protection Agency and British Infection Association recommend that urinary tract infection can be diagnosed when at least three of

the following symptoms are present: dysuria, frequency, suprapubic tenderness, urgency, polyuria, and haematuria.³ However, diagnosis becomes problematic when a patient is unable to provide a clear history of acute urinary symptoms, owing to the high prevalence of asymptomatic bacteriuria. The Scottish Intercollegiate Guidelines Network (SIGN) guidelines recognise the difficulties in older people with the following statement: "In patients over 65 years of age, diagnosis should be based on a full clinical assessment, including vital signs."⁴ Although some experts maintain that a diagnosis of urinary tract infection cannot be made without a clear history of acute urinary symptoms, we recognise that patients who are unable to provide such a history may still develop urinary tract infections.

Thus, in our opinion, when an older person is unable to provide a definitive history of acute urinary symptoms, a urinary tract infection should be diagnosed only when evidence exists of bacteriuria (based on urine culture) and systemic inflammation (for example, fever/hypothermia or raised white cell count or C reactive protein) and, importantly, no other more likely cause of the acute illness exists. The following sections discuss the evidence base for this opinion, including the role and limitations of tests often used to try to confirm the diagnosis of urinary tract infection in older people. The presence of at least two systemic inflammatory response syndrome criteria (see box) is often used to define systemic inflammation, but this may be less useful in older patients.^{5 6}

Character of urine

A change in character of urine is often a trigger for healthcare practitioners to suspect a urinary tract infection.⁸ A prospective cohort study of 399 clinically suspected episodes of urinary tract infection found that gross haematuria, or a change in colour or odour of the urine, had a positive predictive value of 47% (68/144) for bacteriuria plus pyuria.⁹ A change in character of urine may also be caused by dehydration, renal stones, or certain

Learning points

Do not use urine dipstick tests to diagnose urinary tract infection in older people; if they are performed at all, only a negative result should be considered useful in excluding a urinary tract infection

In patients who are able to provide a history, urinary tract infection should be diagnosed only in the presence of a combination of at least three acute urinary symptoms or signs, such as dysuria, urgency, frequency, or suprapubic tenderness

In patients who are unable to provide a history, urinary tract infection should be diagnosed only when evidence exists of acute inflammation (for example, fever/hypothermia or raised white cell count or C reactive protein) associated with bacteriuria on urine culture and no other more likely cause of their acute illness exists

Asymptomatic bacteriuria is common in older people; avoid treating bacteriuria in patients with non-specific symptoms that cannot be attributed to urinary tract infection, as this confers no benefit and may cause harm

Systemic inflammatory response syndrome criteria⁷

- Heart rate >90 beats/min
- Respiratory rate >20 breaths/min
- White cell count >12/μL or <4μL
- Temperature >38.3°C or <36°C
- Blood glucose >7.7 mmol/L in the absence of diabetes
- Acutely altered mental status

foodstuffs. It is not useful in making a diagnosis of urinary tract infection in older people.

Urine dipstick tests

Urine dipstick tests detect the presence of leucocyte esterase and nitrites, which are often used as surrogate markers of an elevated urinary white cell count (pyuria) and Gram-negative bacteriuria, respectively. However, as discussed below, the presence of pyuria or bacteriuria does not necessarily equate to the presence of urinary tract infection.

A prospective cohort study evaluated 101 nursing home residents in America with clinically suspected urinary tract infection.¹⁰ Positive leucocytes or nitrites had a positive predictive value of 45% (95% confidence interval 34% to 56%) for the presence of bacteriuria, whereas a negative dipstick test had a negative predictive value of 100% (74% to 100%). This study lends support to the recommendation from the SIGN guidelines: “Do not use dipstick tests for the diagnosis of UTI in older people.”⁴ In our opinion, if a dipstick test has been done it should be considered useful only if the result is negative and no clinical features of urinary tract infection are present, thus excluding the latter. We do not recommend using urine dipstick tests to rule in the diagnosis of urinary tract infection in older people, on the basis of the evidence available from prospective studies and guideline recommendations.

Urine culture

The purpose of urine culture is to identify bacteriuria and determine sensitivity to antibiotics. A bacterial count of 10⁵ cfu/mL is widely considered to be “significant” bacteriuria,^{11 12} but lower counts have been shown to be relevant in men and women with symptoms of a urinary tract infection.^{13 14}

The diagnosis of urinary tract infection cannot be based on urine culture alone, however, as bacteriuria may be present in asymptomatic healthy people, as discussed in a previous article in this series.¹⁵ In older people, the prevalence of asymptomatic bacteriuria is so high that it cannot be considered an abnormal finding (table 2⇓). The evidence summarised below suggests that treatment of asymptomatic bacteriuria is unlikely to be of benefit and instead may cause harm.

Non-specific symptoms such as fatigue, malaise, and weakness may sometimes be offered as evidence of a potential urinary

tract infection requiring antimicrobial treatment. However, a prospective cohort study did not find any difference in these symptoms between patients with and without bacteriuria.¹⁶ Moreover, prospective randomised trials have shown that the treatment of asymptomatic bacteriuria in older people does not reduce the incidence of symptomatic urinary tract infection or improve chronic genitourinary symptoms,^{17 18} and a randomised controlled trial of 358 patients confirmed that the treatment of asymptomatic bacteriuria does not affect mortality.¹⁹ Young women prescribed antibiotics for asymptomatic bacteriuria in a randomised trial had a threefold higher rate of recurrence of symptomatic urinary tract infection than those not prescribed antibiotics.²⁰

Antibiotic treatment for asymptomatic bacteriuria in older people has not been shown to be of any benefit and may in fact cause harm,¹⁸ as a result of adverse effects such as rash, drug interactions, development of antibiotic resistance, and disruption of the human microbiome, increasing the risk of super-infection. SIGN calculated a number needed to harm of three when antibiotic treatment is given for asymptomatic bacteriuria in older women and advises against treatment of asymptomatic bacteriuria in older people.⁴ Thus urine cultures should not be requested for patients who are asymptomatic or who have non-specific features of “general decline,” which are common in older patients, without evidence of systemic inflammation; they should also not be requested solely on the basis of a positive dipstick test. Requests for urine culture in older people should be limited to two situations. The first is patients with acute urinary symptoms typical of a urinary tract infection, to confirm susceptibility to empirical antibiotic treatment. A negative culture in patients with symptoms does not necessarily rule out infection—for example, if the laboratory does not report bacterial counts below 10⁵ cfu/mL or if the patient has taken antibiotics before sampling. The second is patients who are unable to provide a history of acute urinary symptoms but have features of systemic inflammation, such as fever/hypothermia or raised white cell count or C reactive protein (see Blood tests section), and no other more likely source of infection or explanation for their acute illness.

The UK Standards for Microbiology Investigations recommend midstream urine samples or clean catch specimens for routine diagnosis of bacteriuria.²¹ Alternatively, a sample may be obtained by use of an external condom catheter for male patients.

A prospective cohort study showed that a simple standardised method for collection of urine for culture by external condom catheter had a sensitivity of 90% compared with in and out catheterisation.²²

Urinary white cell count (pyuria)

Clinicians may erroneously interpret pyuria (indicated by an elevated urinary white cell count) as evidence of urinary tract infection in patients with bacteriuria. However, a prospective cohort study found evidence of pyuria in 94% (81% to 97%) of patients with asymptomatic bacteriuria.²³ On the basis of this evidence, the Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria recommend that pyuria is not used to differentiate urinary tract infection from asymptomatic bacteriuria,¹ noting that pyuria may also be found in older people without bacteriuria.

Blood tests

Older patients may not develop a fever in the presence of bacterial infection.²⁴ Blood white cell count or C reactive protein may be used as evidence of bacterial infection but are not specific to urinary tract infection. A prospective cohort study of 221 older people who presented to the emergency department showed that a white cell count threshold of 14 000 cells/mm³ had a positive predictive value of 39% for bacterial infection and a negative predictive value of 90%.²⁵ Another prospective cohort study of 232 people admitted to elderly care wards via the emergency department showed that a C reactive protein of more than 60 mg/L had a positive predictive value of 92% for bacterial infection, with values less than 60 mg/L having a negative predictive value of 90%.²⁶ These studies were not done specifically for the diagnosis of urinary tract infection, so results of blood tests should be interpreted in the context of other clinical features and test results.

Outcome

The patient was admitted to hospital under the care of a geriatric medicine team trained in comprehensive geriatric assessment. She had recently started taking codeine for knee pain and developed symptoms and signs consistent with delirium shortly after. No clinical, biochemical, or radiological features consistent with infection were present, although she was dehydrated. A clean catch urine sample, sent by the emergency department, yielded *Proteus mirabilis* at greater than 10⁵ cfu/mL of urine with pyuria.

She did not receive antibiotics for the bacteriuria, as she had no history of acute urinary symptoms or evidence of systemic inflammation. Instead, a diagnosis of delirium secondary to dehydration and opioid treatment was made. She made a good recovery, following a tailored, multi-component intervention including appropriate fluid therapy, laxatives, and a change from codeine to paracetamol.²⁷

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treatment of asymptomatic bacteriuria. GB reviewed and revised large sections of the article. All authors revised the article further for important intellectual content, and all have reviewed the final draft. SN is the guarantor.

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- Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton TM, et al. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. *Clin Infect Dis* 2005;40:643-54.
- Woodford HJ, George J. Diagnosis and management of urinary tract infection in hospitalized older people. *J Am Geriatr Soc* 2009;57:107-14.
- British Infection Association/Health Protection Agency. Diagnosis of UTI: quick reference guide for primary care. 2011. www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947404720.
- Scottish Intercollegiate Guidelines Network. SIGN Guideline 88. Management of suspected bacterial urinary tract infection in adults. 2012. www.sign.ac.uk/guidelines/fulltext/88/index.html.
- Girard TD, Opal SM, Ely EW. Insights into severe sepsis in older patients: from epidemiology to evidence-based management. *Clin Infect Dis* 2005;40:719-27.
- Wester AL, Dunlop O, Melby KK, Dahle UR, Wyller TB. Age-related differences in symptoms, diagnosis and prognosis of bacteremia. *BMC Infect Dis* 2013;13:346.
- DeLinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med* 2013;41:580-637.
- Juthani-Mehta M, Drickamer MA, Towle V, Zhang Y, Tinetti ME, Quagliarello VJ. Nursing home practitioner survey of diagnostic criteria for urinary tract infections. *J Am Geriatr Soc* 2005;53:1986-90.
- Juthani-Mehta M, Quagliarello V, Perrelli E, Towle V, Van Ness PH, Tinetti M. Clinical features to identify urinary tract infection in nursing home residents: a cohort study. *J Am Geriatr Soc* 2009;57:963-70.
- Juthani-Mehta M, Tinetti M, Perrelli E, Towle V, Quagliarello V. Role of dipstick testing in the evaluation of urinary tract infection in nursing home residents. *Infect Control Hosp Epidemiol* 2007;28:889-91.
- Kass EH. Asymptomatic infections of the urinary tract. *Trans Assoc Am Physicians* 1956;69:56-64.
- Graham JC, Galloway A. ACP Best Practice No 167: the laboratory diagnosis of urinary tract infection. *J Clin Pathol* 2001;54:911-9.
- Stamm WE, Counts GW, Running KR, Fihn S, Turck M, Holmes KK. Diagnosis of coliform infection in acutely dysuric women. *N Engl J Med* 1982;307:463-8.
- Lipsky BA, Ireton RC, Fihn SD, Hackett R, Berger RE. Diagnosis of bacteriuria in men: specimen collection and culture interpretation. *J Infect Dis* 1987;155:847-54.
- Cormican M, Murphy AW, Vellinga A. Interpreting asymptomatic bacteriuria. *BMJ* 2011;343:d4780.
- Boscia JA, Kobasa WD, Abrutyn E, Levison ME, Kaplan AM, Kaye D. Lack of association between bacteriuria and symptoms in the elderly. *Am J Med* 1986;81:979-82.
- Ouslander JG, Schapira M, Schnelle JF, Uman G, Fingold S, Tuico E, et al. Does eradicating bacteriuria affect the severity of chronic urinary incontinence in nursing home residents? *Ann Intern Med* 1995;122:749-54.
- Nicolle LE, Mayhew WJ, Bryan L. Prospective randomized comparison of therapy and no therapy for asymptomatic bacteriuria in institutionalized elderly women. *Am J Med* 1987;83:27-33.
- Abrutyn E, Mossey J, Berlin JA, Boscia J, Levison M, Pitsakis P, et al. Does asymptomatic bacteriuria predict mortality and does antimicrobial treatment reduce mortality in elderly ambulatory women? *Ann Intern Med* 1994;120:827-33.
- Cai T, Mazzoli S, Mondaini N, Meacci F, Nesi G, D'Elia C, et al. The role of asymptomatic bacteriuria in young women with recurrent urinary tract infections: to treat or not to treat? *Clin Infect Dis* 2012;55:771-7.
- Health Protection Agency. UK standards for microbiology investigations: investigation of urine. 2012. www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317132858791.
- Ouslander JG, Greengold BA, Silverblatt FJ, Garcia JP. An accurate method to obtain urine for culture in men with external catheters. *Arch Intern Med* 1987;147:286-8.
- Boscia JA, Abrutyn E, Levison ME, Pitsakis PG, Kaye D. Pyuria and asymptomatic bacteriuria in elderly ambulatory women. *Ann Intern Med* 1989;110:404-5.
- Norman DC. Fever in the elderly. *Clin Infect Dis* 2000;31:148-51.
- Wasserman M, Levinstein M, Keller E, Lee S, Yoshikawa TT. Utility of fever, white blood cells, and differential count in predicting bacterial infections in the elderly. *J Am Geriatr Soc* 1989;37:537-43.
- Liu A, Bui T, Van Nguyen H, Shen Q, Kamalaseena D. Serum C-reactive protein as a biomarker for early detection of bacterial infection in the older patient. *Age Ageing* 2010;39:559-65.
- National Institute for Health and Clinical Excellence. Delirium: diagnosis, prevention and management. NICE, 2010.

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Tables

Table 1 | Definitions of terms relating to urinary tract infection

Term	Definition
Bacteriuria	The presence of bacteria in the urine
Asymptomatic bacteriuria	The presence of bacteria in the urine without typical symptoms or signs of urinary tract infection; quantitative counts of greater than 10^5 colony forming units per millilitre of urine (cfu/mL) are considered diagnostic of asymptomatic bacteriuria if found in a single sample in men or on two consecutive occasions in women ¹
Urinary tract infection	Infection caused by invasion of the urinary tract by microorganisms, with symptoms and signs that can be attributed to such an infection; in patients able to provide a history, these should comprise at least three of the following: dysuria, urgency, frequency, or suprapubic tenderness (see text for discussion of clinical features)

Table 2| Prevalence of asymptomatic bacteriuria in different populations

Population	Prevalence (%)
Older people (>70 years) living in community:	
Women	10.8 to 16
Men	3.6 to 19
Older people (>70 years) living in long term care:	
Women	25 to 50
Men	15 to 40
Patients with long term catheters	100

Adapted from Infectious Diseases Society of America's guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults.¹