Nursing management of urinary tract infections

Sara Ribeiro looks at how nurses can assist older people through the diagnosis, treatment and prevention of a common infection

Abstract

Urinary tract infections (UTIs) are common in older people and can lead to serious complications. Infections can worsen underlying medical conditions, adversely affect recovery and be alarming to patients, their families and caregivers. UTIs have a complex pathophysiology but the most common cause is the ascent of bacteria from the periurethral area, which explains their prevalence in older women. As a result of antibiotic resistance, an accurate diagnosis is imperative and should be based on clinical history, presence of typical signs and symptoms and test results. Nurses can assist patients through the diagnostic process, treatment and prevention of UTIs, promoting their wellbeing and empowerment. This article explores the pathophysiology of UTIs and diagnosis, prevention and nursing management in a variety of care settings.

Keywords

Antibiotics, bacteria, diagnosis, nursing management, urinary tract infections

URINARY TRACT infections (UTIs) are one of the most common bacterial infections in older people and the second most common clinical indication for empirical antimicrobial treatment. Diagnosis is difficult in the older population and requires a systematic approach (Scottish Intercollegiate Guidelines Network (SIGN) 2012a). Older people often present comorbidities with symptoms mistaken for UTIs (SIGN 2012b). Nurses can assist with diagnosis and help prevent future infections by working closely with patients, families and carers.

Aetiology and epidemiology

UTIs are caused by inflammation of the urinary tract. A series of interactions enable bacteria to colonise the periurethral area, ascend into the bladder, multiply in the urine and invade genitourinary tissue causing an immune reaction (Monahan et al 2006). Causative bacteria include Escherichia coli, Klebsiella, Proteus and Enterobacter and Gram-positive bacteria such as Staphylococcus and Streptococcus organisms. The aetiology of UTIs explains their predominance in women and increased risk of infection after catheterisation (Rahn 2008, Grabe et al 2013).

UTIs can also develop as a result of lymphatic or haematogenous spread of an existing infection elsewhere in the body. The infection is restricted to microorganisms such as S. aureus, Candida spp, Salmonella spp and Mycobacterium tuberculosis, which cause primary infections elsewhere in the body (Grabe et al 2013). A prevalence of 16.5% in women over 65 years of age increases to 30% in women over 85, making it a common problem in this group (Rowe and Juthani-Mehta 2014).

Classification

UTIs may manifest as bacteriuria, bacteraemia and urosepsis. Bacteriuria is the presence of bacteria in urine revealed by a quantitative urine culture or microscopy (Grabe et al 2013). It can be asymptomatic or symptomatic, depending on whether the patient presents with typical signs and symptoms of lower or upper UTI (Box 1) (SIGN 2012a). Anatomically, UTIs can be classified as lower, which includes urethritis (infection in the urethra) and cystitis (infection in the bladder), or upper when renal parenchyma and renal pelvis are affected (pyelonephritis) (Monahan et al 2006).

Bacteraemia refers to the presence of pathogens in blood culture. However, blood culture should not be routinely collected except in patients with urinary catheters, malignancies, those who do not respond to antimicrobial treatment (van Nieuwkoop et al 2010) and patients with suspected urosepsis (Kalra and Raizada 2009, Wagenlehner et al 2013).

Urosepsis relates to sepsis originating in the genitourinary tract and is a complex problem with treatment given in critical care (Wagenlehner et al 2013).
A UTI in a person with no structural or functional abnormality of the urinary tract is considered uncomplicated and responds well to antibiotics. Complicated UTIs result from pathogens resistant to commonly used antibiotics and if the person has an anatomical or functional abnormality of the genitourinary system, that interferes with host defence mechanisms, increasing the risk of acquiring infection or of failing therapy. Common abnormalities include obstruction, urinary instrumentation (as in invasive urological tests such as cystoscopy and ureteroscopy, and urologic surgery) and foreign bodies such as indwelling catheters, metabolic disorders, urinary diversion, neurogenic bladder and vesicoureteral reflux (Monahan et al 2006).

Pathophysiology
Bacteria can reach the urinary tract through four main pathways (Grabe et al 2013):

- Infection from the urethra, which explains women’s increased susceptibility as a result of a short urethra and rectal bacterial colonisation of the perineum and vaginal vestibule.
- Haematogenously and lymphatogenously spread occur secondary to an infection elsewhere in the body and are not common.
- Bacteria reach the urinary tract in direct extension via the lymphatic system from another organ associated with intra-peritoneal abscesses.

To colonise the urinary tract, bacteria adhere to the urothelium and secrete toxins that promote their survival. In a healthy urinary tract, a protective layer in the bladder that interferes with this process and efficient micturition decrease the number of bacteria (Monahan et al 2006).

Pyelonephritis is caused either by ascent of bacteria from the lower urinary tract to the kidneys or haematologic spread. It is classified as acute or chronic. Acute pyelonephritis temporarily affects renal function and can eventually result in atrophy and destruction of the tubules and glomeruli.

It manifests as enlarged kidneys and infiltration of inflammatory cells with possible abscess formation. Pyelonephritis is classified as chronic when repeated inflammation and scarring permanently destroy renal tissue, which becomes shrunken and non-functional.

Diagnostic workup often reveals previously unknown urinary tract obstruction or another chronic kidney disease (Hinkle and Cheever 2014).

The urinary tract is the cause of sepsis and septic shock in 10% to 30% of cases and mortality ranges from 30% to 40%, depending on how quickly it is recognised and treated. Urosepsis is mainly caused by obstructive disease in the upper urinary tract with ureterolithiasis being the most common (Wagenlehner et al 2013). It has a complex pathology that starts when bacteria migrate to the bloodstream from the genitourinary tract, releasing endotoxins that damage cells. Damaged cells then liberate pro-inflammatory cytokines and activate the complement cascade, causing urosepsis. Widespread inflammation alters metabolism and results in multi-organ failure secondary to severe sepsis and septic shock (Monahan et al 2006).

Risk factors
Risk factors for UTI usually involve a breakdown in the body’s protective barrier: high osmolality and low pH of urine and vagina; vaginal, periurethral and perineal colonisation by Gram-positive bacteria, diphtheroids and lactobacilli and a normal periodic voiding (the production of 70 to 80ml/h of urine during waking period and 30 to 40ml/h during sleep) (Rahn 2008).

Age-related changes such as increased vaginal pH, weakened immune system and increased skin colonisation with Gram-negative organisms associated with possible cognitive deficits mean older women are susceptible (Rahn 2008, Beveridge et al 2011).

Risk factors for the development of UTIs can be divided into five groups (Box 2) (Grabe et al 2013).

The presence of a urinary catheter is a major risk factor for UTIs and the most common source of bacteraemia. A catheter provides a focus for the formation of biofilm between itself and the urethral mucosa, so bacteriuria occurs within three to four days.

<table>
<thead>
<tr>
<th>Box 1</th>
<th>Clinical manifestations of urinary tract infections</th>
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<tbody>
<tr>
<td><strong>Lower UTI</strong></td>
<td>Bladder tenderness</td>
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<td>Urinary frequency</td>
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<td>Urinary urgency</td>
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<td></td>
<td>Dysuria</td>
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<td></td>
<td>Haematuria</td>
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<tr>
<td><strong>Upper UTI</strong></td>
<td>Symptoms of lower UTI and:</td>
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<td></td>
<td>Chills and fever</td>
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<td></td>
<td>Malaise</td>
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<td>Flank pain</td>
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<td>Costovertebral angle tenderness</td>
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<td>Leukocytosis</td>
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In chronic pyelonephritis, extensive scarring and atrophy result in renal failure manifested by hypertension, increased blood urea and decreased creatinine clearance.

<table>
<thead>
<tr>
<th>Urosepsis</th>
<th>Altered mental status</th>
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<tbody>
<tr>
<td></td>
<td>Fever or hypothermia</td>
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<td>Tachycardia</td>
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<td>Tachypnoea</td>
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<td>Hypotension</td>
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<td>Oliguria</td>
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<td>Leukopenia</td>
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of catheterisation (SIGN 2012a). Although intermittent catheterisation has a lower risk of infection than indwelling, UTIs are the most common complication, especially in patients who perform intermittent self-catheterisation. The causes of intermittent catheterisation-related UTI include inadequate frequency of emptying, inadequate emptying at time of catheterisation, inadequate or excessive fluid intake, poor catheterisation technique and catheter care, traumatic catheterisation and nocturnal polyuria (Newman and Willson 2011).

Diagnosis
According to SIGN (2012a), diagnosis of UTI is difficult, especially in older people, as they are more likely to have asymptomatic bacteriuria. Diagnosis is made based on signs and symptoms and by excluding other possible causes (SIGN 2012b) (Figure 1). When patients exhibit signs and symptoms of UTI, presence and duration of symptoms, predisposing factors and history of previous UTIs should be determined. Physical examination should include assessment of vital signs, abdominal or costovertebral tenderness and the need for a urine culture (Monahan et al 2006). Results of urine culture take between 24 and 48 hours so patients should be reassured that antibiotics might be prescribed without knowing the result (National Institute for Health and Care Excellence (NICE) 2013). In older patients, urinalysis has poor diagnostic value and should not be used (SIGN 2012b).

If urosepsis is suspected, a blood culture is also required as well as initial imaging tests. Further sonographic and radiographic investigation will be needed to determine underlying abnormalities if patients do not respond to therapy within the first 48 to 72 hours (Kalra and Raizada 2009, Wagenlehner et al 2013).

The presence of a catheter is associated with a greater incidence of fever of urinary tract origin and it is commonly present without any localising signs. Due to the presence of bacteriuria and common occurrence of fever, classical symptoms should not be relied on to diagnose UTI in a catheterised patient. New costovertebral tenderness, rigors, new onset of delirium and fever (>37.9°C or 1.5°C above baseline on two occasions over 12 hours) are indications to start antibiotic therapy. Other symptoms to consider are lethargy if no other cause is identified, flank pain, acute haematuria and pelvic discomfort (SIGN 2012a).

**Box 2** *Risk factors for the development of urinary tract infections*

<table>
<thead>
<tr>
<th>Group of risk factors</th>
<th>Risk factor</th>
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<tbody>
<tr>
<td>Risk factors for recurrent UTI, but no risk of severe outcome</td>
<td>Sexual behaviour and contraceptive devices</td>
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<tr>
<td></td>
<td>Hormonal deficiency in post-menopausal women</td>
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<td>Secretory type of certain blood groups</td>
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<td></td>
<td>Controlled diabetes mellitus</td>
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<tr>
<td>Extra-urogenital risk factors, with risk of more severe outcome</td>
<td>Poorly controlled diabetes mellitus</td>
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<tr>
<td></td>
<td>Relevant immunosuppression*</td>
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<tr>
<td></td>
<td>Connective tissue diseases</td>
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<tr>
<td>Nephropathy, with risk of more severe outcome</td>
<td>Relevant renal insufficiency*</td>
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<tr>
<td></td>
<td>Polycystic nephropathy</td>
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<tr>
<td>Urological risk factors, with risk of more severe outcome, which can be resolved during therapy</td>
<td>Urethral obstruction</td>
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<tr>
<td></td>
<td>Transient short-term urinary catheter</td>
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<td></td>
<td>Asymptomatic bacteriuria when associated with other risk factors</td>
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<td></td>
<td>Controlled neurogenic bladder dysfunction</td>
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<td></td>
<td>Urological surgery</td>
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<tr>
<td>Permanent urinary catheter and non-resolvable urological risk factors, with risk of more severe outcome</td>
<td>Long-term urinary catheter treatment</td>
</tr>
<tr>
<td></td>
<td>Non-resolvable urinary obstruction</td>
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<tr>
<td></td>
<td>Poorly controlled neurogenic bladder</td>
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</tbody>
</table>

NB Some risk factors have not been included as they are not applicable to older patients

*Risk factor not well defined (Grabe et al 2013)*

**Nursing management**
Nurses can reassure patients, address concerns and reinforce knowledge of the urinary tract (Newman and Willson 2011). Information should be provided about medication regimen. Patients should complete the full course of antibiotics even after resolution of symptoms to prevent antibiotic resistance (Monahan et al 2006) and use over-the-counter analgesics to control pain (SIGN 2012a). Increased fluid intake so that urine is pale in colour reduces irritation and provides a continual flow of urine (NICE 2013). Patients should avoid bladder irritants, such as coffee, alcohol, spicy food and tomatoes (Monahan et al 2006).

In chronic pyelonephritis, the cause of recurrent infection should be determined and reversed if possible. Nurses should advise patients to monitor urinary output and weight daily, and report if urine volume is inferior to fluid intake and if weight suddenly increases. NICE (2013) recommended hospital admission for patients with pyelonephritis who do not improve in the 24 hours after treatment, are unable to take oral medications and those who respond to medications only available by intravenous administration.

A follow-up appointment is important seven to 14 days after initial infection. This provides an
Are there any symptoms suggestive of non-urinary infection?

Respiratory – shortness of breath, cough or sputum production, new pleuritic chest pain
Gastrointestinal – nausea/vomiting, new abdominal pain, new onset diarrhoea
Skin/soft tissue – new redness, warmth, swelling, purulent drainage

Does the patient/resident have a urinary catheter?

• Shaking chills (rigors)
• New costovertebral tenderness
• New onset delirium

Does patient/resident have one or more of the following symptoms?

• Dysuria
• Urgency
• Frequency
• Urinary incontinence
• Shaking chills (rigors)
• Flank or suprapubic pain
• Frank haematuria
• New onset or worsening of pre-existing confusion/agitation

• Assess if retention or sub-acute retention of urine is likely (eg blocked catheter or distended bladder)
• DO NOT use dipstick test in diagnosis of UTI in older people
• Obtain a sample for urine culture and send to Microbiology
• Start antibiotic therapy following local policy or as advised by Microbiology
• If patient has a urinary catheter, remove and replace it. Consider the ongoing need for a long term catheter in consultation with specialists
• Consider use of analgesia (paracetamol or ibuprofen) to relieve pain
• Consider admission to hospital if patient has fever with chills or new onset hypotension (low blood pressure)
• Review response to treatment daily and if no improvement of symptoms or deterioration, consider hospital admission or raised level of care

Developed by the Scottish Antimicrobial Prescribing Group (www.scottishmedicines.org.uk/SAPG)

(Scottish Intercollegiate Guidelines Network 2012b)
opportunity to obtain a new urine culture and discuss further treatment and preventive measures. At this point, a self-reported pain level less than three on a scale of one to ten, a completed antibiotic course and resolution of symptoms mean the main nursing objectives have been achieved (Monahan et al 2006).

A patient with urosepsis should be treated in the critical care environment where aggressive antibiotic therapy, adjunctive therapies and life-support measures are available. This includes measures to maintain euglycaemia, inotropic and ventilator support (Kalra and Raizada 2009). Treatment plans and end-of-life care should be discussed within the first 72 hours (Wagenlehner et al 2013). Nurses’ presence and support are particularly valuable during this time. As a result of concerns over antimicrobial resistance and healthcare-associated infections, avoiding broad-spectrum antibiotics is important. Empirical treatment should be chosen according to symptoms and local antibiotic policies.

Choice of antibiotic considers spectrum and susceptibility patterns of the aetiological microorganism, efficacy, tolerability, adverse effects, cost and availability (SIGN 2012a, Grabe et al 2013). Public Health England (2015) stated that asymptomatic bacteriuria should not be treated, as it is common in people over 65 years old and not associated with increased morbidity. Treating asymptomatic bacteriuria can lead to increased antibiotic resistance, making future infections more difficult to treat. Antibiotics are also not recommended for patients with indwelling catheters unless symptomatic (Cove-Smith and Almond 2007).

### Table 1 Prevention of catheter-associated urinary tract infections (CAUTIs)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>■ Nurses should always use aseptic technique to prevent cross-infection (Newman and Willson 2011)</td>
<td>■ Connect the catheter to a sterile, closed drainage system with sampling port and avoid breaking this connection</td>
<td>■Assess technique of the person who performs catheterisation</td>
</tr>
<tr>
<td>■ Catheterise before bowel movement to decrease risk of contamination with <em>Escherichia coli</em> (Newman and Willson 2011)</td>
<td>■ Change short-term indwelling catheter and drainage bags when clinically indicated and in line with manufacturer’s recommendations</td>
<td>■ Consider alternative catheter designs to ease insertion</td>
</tr>
<tr>
<td>■ Clean meatus before insertion of catheter using sterile normal saline (Loveday et al 2014)</td>
<td>■ Position drainage system below the level of bladder on a stand that prevents floor contact</td>
<td>■ Consider use of a sterile, closed system or single-use catheters based on medical necessity</td>
</tr>
<tr>
<td>■ Use lubricant from a sterile single-use container and ensure catheter is properly secured to minimise trauma (Newman and Willson 2011)</td>
<td>■ To empty drainage bag use a separate clean container for each patient</td>
<td>■ Drain urine regularly, between four and six times a day, and perform Credé’s manoeuvre as the catheter is removed to ensure adequate emptying (a technique for manual expression of urine from the bladder by holding the hands flat against the abdomen just below the umbilicus and performing a firm downward stroke towards the bladder. This is repeated six to seven times followed by pressure from both hands placed directly over the bladder)</td>
</tr>
<tr>
<td></td>
<td>■ Do not allow the drainage bag to fill more than ¾</td>
<td>■ Encourage regular fluid intake in small volumes spaced hourly reducing intake to sips in the evening</td>
</tr>
<tr>
<td></td>
<td>■ Routine daily personal hygiene is sufficient for meatal cleansing</td>
<td>■ Manage nocturnal polyuria by avoiding large volumes of fluid in the evening and catheterising several times during the night</td>
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</table>

Antibiotic therapy

Lower UTIs are treated with trimethoprim or nitrofurantoin or as an alternative, amoxicillin or an oral cephalosporin. A seven-day course is the ideal treatment, but shorter is usually adequate for uncomplicated UTIs in women. To treat acute pyelonephritis, a broad-spectrum cephalosporin...
or a quinolone is recommended in a course of ten to 14 days, which can be longer in complicated pyelonephritis (British National Formulary 2015). Complicated UTIs are more difficult to treat and hospitalisation is often required. The spectrum of bacteria in complicated UTIs is much larger than in uncomplicated UTIs, and bacteria more likely to be resistant to antimicrobials.

Catheter-associated UTIs are treated with a seven-day antibiotic course or a ten to 14-day course if there is a delayed response to treatment. The catheter should be replaced before starting antibiotic therapy as this increases likelihood of cure or improvement after three days, and decreases duration of fever and reoccurrence of acute symptoms within one month of treatment (SIGN 2012a).

Patients with urosepsis are started on an empirical antimicrobial therapy until results from urine cultures are available, avoiding previously used antibiotics (Wagenlehner et al. 2013). Commonly used antibiotics include third-generation cephalosporin, piperacillin in combination with beta-lactamase inhibitor and fluoroquinolone in a course of 14 to 21 days. Patients who show no clinical improvement within 48 to 72 hours should be reassessed (Kalra and Raizada 2009, Wagenlehner et al. 2013).

Prevention

The most important prevention measures are adequate education and patient concordance (Newman and Willson 2011). Recurrent uncomplicated UTIs can be prevented with the use of a prophylactic dose of antibiotics, if all non-antimicrobial therapies have failed. Antibiotic choice is based on susceptibility pattern of the causative agent and patient history of drug allergies (Grabe et al. 2013).

According to the Alzheimer’s Society (2015a), 850,000 people live with dementia in the UK, a figure set to rise to over two million by 2051. Of this group, 95% are aged over 65. Dementia leads to immobility, difficulty with basic hygiene practices and continence issues (Cove-Smith and Almond 2013). The Alzheimer’s Society (2015b) recommends good fluid intake, regular voiding, good hygiene and avoidance of constipation for those with dementia.

Good fluid intake can be promoted by ensuring patients’ preferred drinks are available and visible, using brightly coloured cups and glasses. Regular voiding can be encouraged by using signs or pictures on toilet doors and seats. If someone is not drinking enough and/or has difficulty with swallowing, an assessment by a speech and language therapist should be considered. Constipation should be avoided by promoting exercise and a diet high in fibre and fluids. Patients should wash their genitals using unperfumed soap, avoid talcum powder and wipe ‘front to back’ after using the toilet. Preventive measures for catheterised patients are outlined in Table 1.

Conclusion

UTIs are common and can have a significant adverse effect on patients’ quality of life. Of the healthcare team, nurses have the most patient contact and the opportunity to identify UTIs sooner and prevent escalation of the infection. Nurses should use the best available evidence and their clinical judgement to assist in the selection of appropriate treatment and relevant care measures that prioritise patients’ wellbeing.

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