Infection in the older patient

Infections in older patients deserve particular attention because of their frequency and severity, as well as atypical clinical presentation and adverse outcomes. This article describes age-related physiological changes and explores in more detail two of the more common types of infections which may be encountered, discussing diagnosis and highlighting the complexity of disease management in the older patient.

Physiological changes with age

The risk of acquiring an infection increases with advancing age as a result of a number of influences. Multiple comorbidities increase the likelihood of exposure to medical intervention and invasive clinical procedures such as urinary catheterization. Accompanying immunosenescence, malnutrition, decreased mobility and institutionalization further increases the risk of infection (Gavazzi and Krause, 2002; Liang and Mackowiak, 2007; Hepper et al, 2013). Immunosenescence is outlined in more detail in *Table 1*.

In response to physiological stress, older patients with multiple comorbidities often present with functional impairment and loss of adaptability. The most common comorbidities to trigger infection include heart failure and diabetes mellitus type 2. In addition, functional reserves are reduced as a result of the combination of sarcopenia and reduction in bone and cartilage strength. This hampers thoracic expansion and can limit respiratory effort while skin fragility weakens barrier protection. Anatomical changes to the bladder, prostate and to the urothelium of the urinary tract promote the development of asymptomatic bacteriuria. This is paralleled by an increase in symptomatic urinary tract infections (Gavazzi and Krause, 2002; Hepper et al, 2013).

Malnutrition is a prevalent problem in older people, affecting 10–25% of community dwellers and up to 50% of those requiring hospitalization. It is not only a major risk factor for infection but conversely infection also leads to malnutrition. This is particularly relevant as older patients do not have a good nutritional reserve, leading to a vicious cycle in which malnutrition leads to infection which further exaggerates malnutrition (Gavazzi and Krause, 2002).

The impact of institutionalization

Up to 16% of people above the age of 85 years live in a care home compared to only 3% of those over 65 years. In long-term care facilities, bacterial flora resistance to antibiotics is higher than in the community. Oro-pharyngeal colonization with Gram-negative bacilli is associated with institutionalization and when combined with depressed cough reflex and mucociliary transport function, leads to increased risk of pneumonia. Institutionalization increases the risk of complications such as pressure ulcers and colonization or infection by multi-resistant organisms especially Gram-negative organisms such as *Escherichia coli* and meticillin-resistant *Staphylococcus aureus* (Gavazzi and Krause, 2002; Hepper et al, 2013).

Clinical manifestation of infection in older patients: atypical presentations and diagnostic challenges

While a younger adult may present with a typical cluster of several symptoms for a given condition, older patients tend

Table 1. Immunosenescence: key features

Definition	Complex and dynamic phenomenon characterized by a decline in cell-mediated, or adaptive, immunity		
Potential consequences	Immune dysfunction leading to increased infection risk and impaired immune defence		
	Chronic inflammation leading to conditions such as diabetes mellitus and atherosclerosis		
	Increased susceptibility to cancer and autoimmune diseases		
	Decreased antibody response to vaccinations		
Age-related changes	Innate immunity	Increased inflammatory background	
		Impaired capacity of phagocytes and oxidative burst of macrophages	
		Elevated natural killer cell numbers with reduced cytotoxic function	
	Adaptive immunity	T cells	Thymic involution leading to decreased naïve T cell output
			Accumulation of effector T cells
			Restrictive T cell repertoire
		B cells	Reduced B cell production
			Decreased generation of specific antibodies
			Increased generation of autoantibodies

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to have fewer specific symptoms. Co-existing chronic diseases such as chronic emphysema or heart failure may further confound typical presentations with infection. This means that the classical medical model, where the medical history and clinical signs point towards a specific diagnosis or a narrow differential diagnosis, frequently does not apply to the older patient. The most common symptoms in older patients tend to be non-specific and include falls, altered mental state (delirium, drowsiness or coma), reduced appetite, urinary incontinence or generalized weakness. A clinician seeing an older patient with such symptoms should strongly consider infection as the underlying cause. A good history and examination are key to differentiating acute from chronic symptoms and identifying what has changed compared to the patient's usual baseline (Gavazzi and Krause, 2002; Hepper et al, 2013).

Older patients' normal body temperatures span a wider range, with a substantial proportion having a baseline body temperature below 36°C. They also have a decreased ability to generate a febrile response because of the impaired ability to conserve heat and changes in central temperature regulation. Older patients are therefore less likely to develop a fever (temperature above 38°C) than younger patients in response to infection, making the diagnosis of infection even more difficult (Liang and Mackowiak, 2007; Hepper et al, 2013).

> "Factors including large post-void residual volume, urinary incontinence and structural abnormalities such as cystocoeles may contribute to the increasing incidence of urinary tract infections."

Common infections in older patients

Investigation and management of infection is a potentially complex and certainly varied area of medicine. A thorough clinical assessment is the starting point in each case, and the initial findings will guide the ongoing investigation and management approach.

Two of the more common infections seen in older patients are discussed in more detail below. *Table 2* offers a brief overview of alternative sources of infection that may be considered, as well as a selection of key aspects relevant to older patients.

Urinary tract infection

The prevalence of urinary tract infections increases with age. Infections originating in the urinary tract have been reported to account for up to 40% of nosocomial infections. The female-to-male predominance becomes less pronounced with age. In patients over 70 years the ratio may be as little as 2:1, compared to 50:1 in younger cohorts (Cove-Smith and Almond, 2007).

Factors including large post-void residual volume, urinary incontinence and

Table 2. Alternative sources of infection to consider and some relevant aspects in older patients

Source	Considerations in the older patient
Biliary sources (cholangitis or cholecystitis)	More likely to have comorbidities which may discourage surgeons from attempting cholecystectomy even for initially asymptomatic cholelithiasis
	Older patients have poorer outcomes from emergency cholecystectomy than do younger
	Presentation of even severe cholecystitis can be atypical, with minimal fever and few abdominal symptoms leading to an underestimation of the underlying pathology (Siegel and Kasmin, 1997)
Skin and soft tissue infections	Secondary skin infections may occur as a result of pruritus associated with ageing skin (Laube and Farrell, 2002)
	Infections may be associated with pre-existing skin ulcers, whether from pressure areas or related to other conditions such as diabetes or vascular disease
	In the case of contagious conditions such as impetigo, the patient's environment must be considered to avoid spread
Osteomyelitis	As with skin and soft tissue infections, osteomyelitis may be associated with pre-existing skin ulcers. Predisposing comorbidities such as peripheral vascular disease and diabetes have a higher incidence in older patients
Infective endocarditis	There may be degenerative disease of native valves which predispose to the development of infective endocarditis
	Older patients are more likely to have prosthetic valves or intracardiac devices, and these predispose to infective endocarditis
	Causative organisms vary depending on the age and comorbidities of the patient; in the older population colonic lesions are more common and may provide a portal of entry to gut-colonizing organisms (Forestier et al, 2016)
CNS infection (meningitis or encephalitis)	Older patients may present with fewer classical symptoms, or symptoms may be attributed to an alternative mechanism. For example, it may be difficult to judge confusion or disorientation on a background of pre-existing cognitive impairment (Choi, 2001)
	The rate of complications is higher in older patients
	Choice of empirical antibiotic must be adapted to cover *Listeria monocytogenes* which is seen with increased frequency in this population

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structural abnormalities such as cystocoeles may contribute to the increasing incidence of urinary tract infections. The former can result from impaired bladder emptying secondary to neurological conditions such as cerebrovascular disease and Parkinson's disease, which are themselves more common with age. In men, prostatic disease can cause obstruction of urinary flow and this physiological factor may go some way to explaining the changing ratio between the sexes with advancing age (Beveridge et al, 2011).

An unclear history, non-specific symptoms, or a carer's report of strong-smelling urine can make this a prime differential in an older patient. It is important to identify and treat infections promptly but there may be challenges in diagnosing a urinary tract infection. Co-existence of delirium or dementia can make it difficult to ascertain a history of urinary symptoms. In the presence of multiple comorbidities and numerous possible sources of infection, teasing out the underlying pathology from vague presentation may not be straightforward.

Presence of bacteria or inflammatory cells in the urine does not necessarily mean that there is an acute infection. Studies have quoted that up to 50% of older women and 40% of older men in long-term care have bacteriuria. Of these, up to 90% may also have pyuria (Nicolle et al, 2005). There is a fine balance to be struck as clinically significant infections must be treated but over-diagnosis and prescription of unnecessary antibiotics must be resisted. Injudicious use of antibiotics carries the risk of *Clostridium difficile* infection or development of drug-resistant organisms.

Current Scottish guidelines (Scottish Intercollegiate Guidelines Network, 2012) suggest that urine dipstick should not be used to diagnose urinary tract infections in older people, and they acknowledge that evidence regarding the utility of nitrite and leucocyte esterase is lacking. The emphasis should be on a thorough physical assessment (including vital signs), and vigilance when questioning about new symptoms such as dysuria and urinary incontinence and careful exclusion of other potential sources of infection. Ninan et al (2014) propose that a dipstick test should only be considered useful if the result is negative and there are no clinical features of urinary tract infection.

Presence of a long-term urinary catheter is common in older patients and adds another layer of complexity to the diagnosis and management of urinary tract infections. Poor cleansing before insertion of a urinary catheter can introduce organisms directly into the urinary tract. Biofilms can form on the catheter, providing a haven for bacteria which then resist being dislodged by urinary flow (Tenke et al, 2008). If adherent to the catheter surface, the organisms forming the biofilm may not be detected on routine urine culture, making a microbiological diagnosis challenging. Among all catheterized patients, the daily risk of acquiring bacteriuria has been reported as between 3 and 7%, with higher rates among women and older patients.

Bacteriuria is virtually inevitable when a catheter has remained in situ for a number of weeks (Nicolle, 2014). With this in mind, it is important to consider alternative sources of sepsis in catheterized patients who become unwell. A thorough examination to assess for clinical correlation such as suprapubic tenderness or loin pain is important. In addition, it is recommended that a urinary catheter should be changed immediately where there is suspicion of associated urinary tract infection and that a urine sample is obtained from the new catheter (Beveridge et al, 2011; Scottish Intercollegiate Guidelines Network, 2012). The most effective way to avoid these complications is to limit the duration of use of a urinary catheter.

E. coli has been reported as the most common causative organism for urinary tract infection in older patients, along with *Klebsiella pneumoniae* and *Proteus mirabilis*. Local guidelines on antibiotic prescribing vary according to local resistance patterns but recommendations are frequently based on younger, generally healthy populations (Beveridge et al, 2011). Selecting antibiotics for an older patient with urinary tract infection can be more complex, since he/she may have had multiple previous courses of antibiotics or be resident in a care facility. In both circumstances drug resistance rates are high. Renal insufficiency and polypharmacy increases the potential for adverse drug interactions and can limit choices. As with any infection, treatment should be delayed if clinically justifiable until culture and sensitivities are available. Where empirical treatment is warranted, the patient's previous microbiological diagnoses should be reviewed in order to determine organism sensitivities.

Pneumonia

The annual incidence of pneumonia has been reported at between 25 and 44 per 1000 of the population over the age of 65 years, with higher rates in institutionalized individuals (Janssens and Krause, 2004). More than half of all deaths from pneumonia occur in those aged 84 years or over, and data from the Office for National Statistics (2014) indicate that pneumonia or influenza were the sixth commonest cause of death among men, and the fourth among women.

There are comorbid features prevalent in the older population which may increase the risk of developing pneumonia. In patients with dementia, aspiration of oropharyngeal flora may occur. There may be impairment of swallow secondary to a stroke which increases the risk of aspiration pneumonia. Artificial measures to assist with feeding such as nasogastric tubes and gastrostomies do not eliminate the risk of aspiration.

Guidelines from the British Thoracic Society (2015) recommend that sputum culture be obtained for all patients with moderate severity community-acquired pneumonia who have not previously received antibiotics, and even more importantly in severely affected patients who fail to improve. This in itself can present great challenges in older patients. Gaining a good quality sputum sample is more difficult in older patients with underlying delirium or dementia.

The British Thoracic Society (2015) guidelines for the management of community-acquired pneumonia also explored the available research into

the aetiology of community-acquired pneumonia in older patients. They concluded that for most organisms, the frequency is comparable between young and old people, although *Legionella* and *M. pneumoniae* are seen less often in the latter. Among both groups, *Streptococcus pneumoniae* is the most commonly identified organism.

Among institutionalized individuals, as well as in those presenting from the community, *S. pneumoniae* has been reported as the most common causative organism (Janssens and Krause, 2004) . However, there remains some dispute within the literature regarding the incidence of *Pseudomonas aeruginosa* and drug-resistant pathogens in healthcare-associated pneumonia (i.e. from nursing or residential homes) compared to community-acquired pneumonia. Some researchers have found low frequencies of such organisms in both community-acquired pneumonia and healthcare-associated pneumonia groups, while other studies have identified higher frequencies of multiresistant organisms among patients treated for healthcare-associated pneumonia (Chalmers et al, 2011).

Outcomes

Sepsis contributes to almost 20% of in-hospital deaths. Risk factors for mortality include multiple comorbidities, diminished cardiopulmonary reserve and age-related decrease in organ function. Increasing age is associated with a higher mortality rate and patients over the age of 80 years with sepsis are twice as likely to die as those under the age of 50 years, independent of the severity of sepsis or any comorbidities. Of those who survive, up to 45% of older patients may require a care home following discharge (Martin et al, 2006).

Diagnosis and initiation of treatment for sepsis in older patients may be delayed because of vague symptoms or atypical presentation and this may contribute to higher morbidity and mortality. Any treatment that is offered may be less aggressive in the context of terminal illness or severe comorbidities where there might be poor tolerance of invasive treatments.

Patients with dementia are at particular risk of infections, sepsis and death. They are at increased risk of delirium, more likely to be frail or be institutionalized, and less likely to engage with health prevention strategies such as vaccination (Shen at al, 2012).

Conclusions

While infections are an important cause of morbidity and mortality in older patients, there are measures that can be taken which may help to prevent their occurrence. Promoting mobility and independence, ensuring good nutritional intake to preserve muscle mass and body weight, encouraging sufficient hydration, offering vaccinations and importantly avoiding hospital admission can reduce the burden of infection in older patients. **BJHM**

Conflict of interest: none.

KEY POINTS

- Older patients are at increased risk of infections because of altered physiology, multiple comorbidities, institutionalization and malnutrition.
- The two most common infections in older patients are pneumonias and urinary tract infections.
- An unclear history, non-specific symptoms and difficulties in obtaining diagnostic samples makes the diagnosis and management of sepsis more challenging.
- A positive urine dipstick alone should not be used to diagnose urinary tract infections as up to 50% of older patients have asymptomatic bacteriuria.
- While treating clinically significant infections promptly is important, this needs to be balanced against the risk of over-diagnosis and injudicious antibiotic prescription.

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