REVIEW

Special considerations of antibiotic prescription in the geriatric population

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Abstract

Infectious diseases pose a major challenge in the elderly for two reasons: on the one hand the susceptibility to infection increases with age and when infections occur they often present atypically—on the other hand diagnostic uncertainty is much more pronounced in the geriatric population. Reconciling the opposing aspects of optimizing patient outcomes while avoiding antibiotic overuse requires significant expertise that can be provided by an infectious diseases consultant. In addition, geriatric facilities are reservoirs for multidrug-resistant organisms and other nosocomial pathogens, and infectious diseases consultants also play a vital role in assuring appropriate infection control measures. In this review we outline the challenges of diagnosis and management of infectious diseases in the elderly, and discuss the importance of appropriate antibiotic use in the elderly in order to demonstrate the value of the infectious diseases consultant in this special setting.

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The aging population

Over half of all deaths in many countries now occur in hospitals, even without taking into account deaths occurring in residential aged care institutions [1]. The vast majority of in-hospital deaths occur among the elderly and the very old. In the USA for example, in 2010 75% of inpatients who died in a hospital were aged 65 years and over and 27% were aged 85 years and over [2]. Infections, such as pneumonia, often directly contribute to the mortality in these patients, as suggested by the term 'end-of-life pneumonia' [3]. This poses challenges with regard to the use of 'end-of-life' antibiotics, which may lower suffering but also may exacerbate selection pressure for antimicrobial resistance [4–6]. The prevention, diagnosis and management of infections in geriatric patients, requires the expertise of infectious diseases (ID) consultants with an interest in this area of medicine. In addition, ID consultants also have a major role in promoting the judicious use of antibiotics in this population, since it is also particularly vulnerable to the deleterious effects of inappropriate antibiotic use, such as adverse drug reactions, antimicrobial resistance and *Clostridium difficile* infection [7].

The high risk of infectious diseases in the elderly

While aging is a normal process, and not in itself a disease, age-related physiological changes place the elderly at high risk for infectious diseases [8]. These diseases are therefore a leading cause of hospital admission and cause of death in this patient population [9]. Susceptibility to infectious diseases in the elderly is increased by a combination of factors, including immune senescence (such as changes in B-cell and T-cell function, innate immune responses and effector functions), as well as altered skin and mucosal barrier function, degenerative changes in bone and cartilage and reduction in respiratory capacity [9–11]. Urinary catheters are often used in geriatrics facilities and

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prevalence estimates of these devices range between 6 and 40%, depending on the population studied [12]. Approximately 3–7% of nursing home residents with an indwelling urinary catheter will acquire a urinary tract infection with each day that the catheter remains in place. The changes in immune system function in the elderly lead to reduced responsiveness to vaccination, and increased susceptibility to systemic infection by specific pathogens such as *Listeria monocytogenes*. Additionally, reactivation of latent infection such as *Mycobacterium tuberculosis* and varicella zoster virus is also more common [13–15]. Common co-morbidities found in the aging population also contribute to an increased risk of infection, such as pulmonary diseases increasing the risk of pneumonia, and the frequent presence of foreign material, such as joint prostheses, pacemakers or artificial cardiac valves, enhancing risk of prosthetic device infection [16].

Elderly patients in institutions, such as nursing homes or geriatric hospitals, pose a particular challenge. Not only does this group of patients tend to have more pronounced impairment of defences against infection, and a large number of co-morbidities, but common activities (e.g. common meals) combined with suboptimal hygiene (e.g. due to a high proportion of patients with dementia) promote rapid dissemination of respiratory and gastrointestinal viruses (e.g. influenza virus and norovirus) and multidrug-resistant organisms (MDROs) [16,17]. Several studies have shown that age remains an important risk factor of carriage of MDROs, independent of other determinants [18]. Furthermore, geriatric hospitals may have a higher prevalence of nosocomial infections compared with acute-care settings, even after adjustment for case-mix [19]. The outcome from infection is often worse in elderly populations. For example, mortality related to *Staphylococcus aureus* bacteraemia has been extensively studied, and shows a significant increase in mortality in the later decades of life [20,21]. Prognosis for severe infections, particularly in geriatric patients more than 80 years of age, is clearly linked to functional status [22].

Unusual presentation of infectious diseases in the elderly

Common infections such as urinary tract infections, lower respiratory tract infections and skin and soft tissue infections, are frequent in the elderly [16]. Unfortunately, however, the diagnosis of infection in the elderly is not always straightforward and obvious. Symptoms and signs of infection in the elderly may not include the typical features such as fever and chills that clinicians usually rely on to make a clinical diagnosis of infection [23,24]. This is because of altered physiological responses to the infecting pathogen in this patient group, and age-related changes in temperature regulation [25]. Older subjects have a lower body temperature than that of younger people and their tolerance of thermal extremes is more limited. Instead, symptoms may mimic normal signs of aging or a concomitant disease, or symptoms may be non-specific such as when elderly patients with pneumonia present solely with confusion. Conversely, patients may have fever without apparent infections complicating the decision to administer antibiotics to elderly patients [24]. In addition, accurate history taking is often complicated by cognitive impairment, the physical examination is often hampered by lack of cooperation and the positive predictive value of many diagnostic tests is lower than in the other populations (e.g. chest X-rays or urinary cultures).

Acute confusion or disturbance of consciousness is one of the common atypical (relative to non-elderly) primary manifestations of infection in geriatric patients [9]. In an analysis of 73 consecutive acute admissions of patients older than 70 with impaired consciousness, the proportion where a presumed infection was the triggering cause was 34.3% [9]. Other non-specific manifestations of infection in the elderly can include acute deterioration of mobility, and subtle disturbances of circulatory regulation (hypotension and lactic acidosis without overt toxaemia or tachycardia) [9]. Altered cognitive states such as dementia or acute confusion often hamper the ability of the clinician to obtain important details regarding relevant symptoms or risk factors for infection, further complicating the process of accurate clinical diagnosis in this patient group [26]. Laboratory markers of infection may not show responses found typically in younger patients. Inflammatory markers are often initially not elevated or are minimally abnormal in the infected geriatric patient, further contributing to delays in diagnosis and therapy [27,28].

The presentation of urinary tract infections in the elderly may be atypical. Positive urinary cultures without active infection are very common in the elderly, reducing the positive predictive value of bacteriuria for diagnosing urinary tract infections and, in the absence of better performing diagnostic tests, making it difficult—if not impossible in certain cases—to differentiate between asymptomatic bacteriuria and active urinary tract infection [8,9].

The frequency of bacteraemia increases in elderly patients, and is one of the leading causes of morbidity and mortality in the geriatric population [29]. Fever, chills and shakes are less likely to be present; however, fever remains common in bacteraemic geriatric patients [30,31]. End-organ effects are reported to be more common in the elderly bacteraemic patients, with manifestations such as renal failure and respiratory compromise [31]. There does not appear to be a difference in

