CLINICAL REVIEWS

Bacteremia in the Elderly

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THE ELDERLY ARE MORE SUSCEPTIBLE to a variety of infectious diseases, including tuberculosis, pneumonia, influenza, urinary tract infections,[1] and tetanus.[2] The incidence of bacteremia is also increased in the elderly.[3] In this article we review bacteremia in elderly populations. Recent reports have been published of studies of elderly hospitalized patients with bacteremia,[4-7] of bacteremic patients with pressure ulcers,[8] of patients with bacteremia in extended care facilities,[9, 10] and of elderly patients with gram-negative bacteremia[3] (Table 1). The presentation of bacteremia in the elderly, risk factors, influences on mortality, and treatment considerations are discussed.

DEFINITION

Bacteremia is defined as the presence of bacteria in the bloodstream,[11] and is detectable in practical terms only by obtaining blood cultures. Although bacteremia is detectable by other means, there is no "gold standard" with which to evaluate blood culture results.[12] Calculating sensitivity and specificity for obtaining blood cultures is therefore difficult, and clinicians are heavily dependent upon blood culture results when determining whether patients have significant bacteremia. Aronson and Bor have calculated that for most clinical situations involving the typical medical patient, obtaining two or three blood cultures maximizes sensitivity and specificity.[12] (For further considerations of blood cultures as laboratory tests, the reader is referred to their review.[12])

CLINICAL PRESENTATION

Nonspecific symptoms are common at the initial presentation of bacteremia in the elderly[5, 6] (Table 2). For example, in a retrospective study of 50 consecutive patients with bacteremia admitted to a geriatric unit, 15 (30%) had experienced weakness and falls; five of these patients had been found on the floor at home.[6]

About 90% of bacteremic hospitalized elderly patients[7] and patients in extended care facilities[10] are febrile at presentation. However, there have been reports of elderly patients who were afebrile at the time of presentation of their bacteremias.[5, 13] Temperatures less than 97°F occur more rarely.[4, 6, 7]

As often occurs in geriatric patients with severe illnesses, especially infection, altered mental status such as confusion or delirium is frequently noted. Meyers et al.,[7] in a review of 100 episodes of bacteremia in patients over the age of 65 years at the Mt. Sinai Hospital in New York, found that 52% had presented with altered mental status. A similar proportion of patients with confusion, drowsiness, or delirium has been noted in bacteremic geriatric patients on a geriatric unit,[5] and in a Veterans Administration extended care facility.[10]

Elderly patients presenting with bacteremia often lack localizing symptoms even when the etiologic factor of the bacteremia has been clearly established. For example, in a retrospective study of 100 consecutive geriatric patients with community-acquired bacteremia admitted to a community hospital, only six of the 34 patients with urinary tract infections and bacteremia complained of dysuria, urgency, or other symptoms suggestive of a urinary tract infection.[4] Similarly, Windsor found that none of 12 bacteremic patients with urinary tract infections gave a history of dysuria or urinary frequency, although six were incontinent as a result of altered mental status.[6]

A few common laboratory findings have been noted in elderly bacteremic patients. About 60% to 70% of these patients have leukocytosis.[6, 7] Leukopenia has also been reported.[4, 6, 7] Other abnormal laboratory findings at onset of bacteremia have included elevated blood urea nitrogen[5, 10] and elevated bilirubin.[4, 6]

RISK FACTORS

Only a few studies have suggested possible risk factors for bacteremia in the elderly. Increasing age,[3] possibly because of concomitant deterioration of the immune system, has been implicated.[1, 6, 7] The increased prevalence of chronic diseases in the elderly, including cardiac, pulmonary, and neoplastic disease, has also been suggested as an etiologic factor.[5, 7]

Catheterization of the genitourinary tract was a strong risk factor (odds ratio = 39) for bacteremia in a review of 42 episodes of bacteremia in a Veterans Administration extended care facility.[10] These investigators also found a significant association between an increased incidence of bacteremia and a diagnosis of

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Alzheimer's disease, hypoalbuminemia, hypocholesterolemia, anemia, hyperglycemia, and chronic urinary tract infection. Hypoalbuminemia was also an independent risk factor for bacteremia in a recent study of adults hospitalized with febrile illnesses.[14]

SOURCES OF BACTEREMIA

The genitourinary tract is the most common tissue source of bacteremia in almost all studies, ranging from about 24%[6] to 56%.[9, 10] Other common sources of bacteremia are the lungs, the intra-abdominal organs, including the biliary tract, and the skin (Table 1).

Bacteremias caused by gram-negative isolates are more prevalent than those caused by gram-positive organisms, accounting for over 60% of cases[5, 7, 9, 10] (Table 1), although Windsor found that gram-positive organisms represented 58% of the isolated organisms in 50 patients with bacteremia admitted to a geriatric unit over four years.[6] Most authors have found gram-positive

TABLE 1

Studies of Bacteremic Elderly

Reference*	Population	Tissue Source	Organisms†	Mortality
Esposito et al., 1980[4]	Retrospective; 100 consecutive patients ≥ 65 years old hospitalized with bacteremia	Genitourinary (GU) 34% Biliary tract 20% Lungs 13% Unknown 11%	Gram-negative 61% *Escherichia coli* 35% Klebsiella 11% Pneumococcus 11% *Staphylococcus aureus* 6%	26%
Madden et al., 1981[5]	Retrospective; 44 elderly patients admitted to a geriatric service 1974–1980; 39 eligible	GU 44%	Gram-negative 67% *E. coli* 44% Pneumococcus 18% Proteus 13% *Streptococcus viridans* 7.7%	15%
Windsor, 1983[6]	Retrospective; 50 cases managed in a geriatric unit over a 4-year period (hospital- and community-acquired)	GU 24% Lungs 22% Unknown 20% Joints 10% Skin 8% Biliary 8%	Gram-positive 58% *S. aureus* 20% *E. coli* 14% Beta-hemolytic streptococci 12% Pneumococcus 12%	24%
Bryan et al., 1983[8]	Prospective; 104 episodes of bacteremia in 102 patients in 4 hospitals over 5 years with decubiti; average age 64 years	51 episodes in which decubitus ulcer was judged a "probable" source of bacteremia	*Proteus mirabilis* 19% *S. aureus* 16% *Bacteroides fragilis* 16% Group A streptococci 10%	31% of those with "probable" bacteremia due to decubiti
Setia et al., 1984[9]	Prospective; 100 consecutive patients with bacteremia in an extended care facility	GU 56% Skin 14% Lungs 10%	Gram-negative 67% Gram-positive 24% Polymicrobial 9% *E. coli* 31%	35%
McCue, 1987[3]	Retrospective; 135 patients ≥ 70 years old in a North Carolina teaching hospital from 1979 to 1982 with gram-negative bacteremia	GU 52%	*E. coli* 82% *Klebsiella pneumoniae* 15% Proteus 13% Pseudomonas 11%	19.3% overall; 9.1% in elderly without fatal disease
Rudman et al., 1988[10]	Retrospective; 533 patients in a Veterans Administration extended care facility in 1985; 42 episodes in 34 men	GU 56% Lungs 7% Skin 7% Unknown 22%	Gram-negative 63% Providencia 20% Proteus 15% *E. coli* 12% *S. aureus* 7% Enterococcus 7% Pneumococcus 7%	21%
Meyers et al., 1989[7]	Retrospective; All patients ≥ 65 years with positive cultures at a New York hospital from 1984 to 1986	GU 27% Unknown 21% Intra-abdominal 16% Lungs 12%	Gram-negative 60% *E. coli* 22% Klebsiella 11% *S. aureus* 13% Enterococcus 10%	40%; 34% in community-dwelling elderly and 28% in nursing home patients

*For complete reference citations, see the reference list.

†Classification by Gram stain refers to percentage of patients with bacteremia caused by a single strain of a gram-positive or gram-negative organism; percentage by organisms refers to percentage of total isolates.

organisms to account for between 24%[9] and 36%[10] of bacteremic episodes.

Escherichia coli is the most common gram-negative organisms recovered in studies of bacteremia affecting community-dwelling elderly patients, accounting for between 14%[6] and 43.6%[5] of isolates. Klebsiella, Providencia, and Proteus are also commonly isolated (Table 1).[3, 5-7, 9, 10] *Bacteroides fragilis* and *Pseudomonas aeruginosa* are found less frequently.[5-7, 9, 10]

Staphylococcus aureus is the most frequent gram-positive organism isolated, accounting for between 12.8%[9] and 20%[6] of total isolates. Other gram-positive organisms frequently found include enterococci, *Streptococcus pneumoniae*, and *Streptococcus viridans*.[5-8, 10]

TREATMENT AND MORTALITY

Mortality in bacteremic elderly patients varies from 9.1% in community-dwelling elderly patients with gram-negative bacteremia and more than five years' life expectancy[3] to 47.2% in elderly patients with nosocomial bacteremia.[7] Several authors have examined the risk factors for mortality from bacteremia in the aged. In one study of 104 episodes of bacteremia in 102 patients with pressure ulcers, Bryan et al. found 51 cases where pressure ulcers were the probable cause of bacteremia.[8] Sixteen of these patients (31%) died. Appropriate antibiotic therapy did not influence mortality in this study.

A study of gram-negative bacteremia in a community hospital found that mortality was increased in elderly patients with hospital-acquired bacteremia, in patients with bacteremia of nonurinary source, in neutropenic patients, and in patients not treated with appropriate antibiotic therapy within the first 24 hours.[3] In another study of hospitalized elderly with bacteremia, Meyers and colleagues found the following factors associated with increased mortality in patients treated with inappropriate antibiotic therapy: *S. aureus* infections, infections in the lower respiratory tract, and age more than 85 years. Additionally, a white blood cell count less than 5,000 per cubic milimeter was also associated with poor survival, regardless of the source of the bacteremia.[7]

Mortality due to bacteremia in the elderly also seems to be influenced by the site of care of the patient. The highest mortality occurs in hospitalized patients with nosocomial infections, and the lowest mortality in community-dwelling elderly patients admitted to the hospital with bacteremia. For example, in the study by Meyers et al., elderly patients with hospital-acquired bacteremia had a mortality rate of 47.2%.[7] In McCue's study of gram-negative bacteremia in a community hospital, 12.4% of patients with community-acquired gram-negative bacteremia over 70 years of age died, compared with 32.6% of elderly patients with hospital-acquired gram-negative bacteremia.[3] Likewise, only six of 39 (15%) community-dwelling elderly admitted to a geriatric evaluation unit with bacteremia died.[5] In a review of 100 consecutive cases of bacteremia in elderly patients admitted to a suburban hospital, mortality was 26%.[4]

TABLE 2

Frequent Presenting Signs and Symptoms of Bacteremia in the Elderly, Arranged in Descending Order of Approximate Frequency

Fever
Lethargy
Confusion
Incontinence
Tachycardia
Rigors/chills
Falls
Nausea/vomiting
Hypotension
Abdominal pain
Dysuria
Diarrhea

Mortality rates in extended care facilities appear to be between those of community-dwelling elderly patients who are hospitalized for bacteremia and those of elderly patients with hospital-acquired bacteremia, ranging from 21%[10] to 35%.[9] Coexistent disease states appear to influence survival of bacteremia and may account for the differences in the mortality rates between these settings.[4, 10] Meyers et al.[7] postulated that mortality was reduced in patients with community-acquired gram-negative bacteremia because the majority of isolates were easily managed pathogens originating in the urinary tract. Similarly, most cases of bacteremia in residents of extended care facilities originate in the urinary tract, which may explain the reduced mortality in these patients with bacteremia.[7] As noted above, mortality in bacteremia is also related to the presumed source of bacteremia. In the study by Meyers et al.,[7] mortality was least in bacteremias originating from the genitourinary tract (30%). In his study of gram-negative bacteremia in patients aged 70 years older, McCue found a mortality rate of 12.9% for patients with bacteremia originating from the genitourinary tract compared with a mortality rate of only 26.2% for all other patients.[3] The mortality among nursing home patients with genitourinary sources of bacteremia was 23% compared with the mortality of 50% among nursing home patients whose bacteremias had skin or respiratory sources.[9] In contrast, Rudman and colleagues did not find differential mortality rates by site of entry of the bacteremia but did find a higher mortality rate of 35% for patients who had polymicrobial bacteremias, compared with an overall rate of 21%.[10]

Antibiotic treatment of elderly patients suspected to have bacteremia must be empiric until culture results have been obtained. Although further study of treatment for bacteremia in the elderly is necessary,

prompt appropriate antibiotic therapy may reduce mortality. Antibiotics should be chosen for coverage of *S. aureus*, aerobic gram-negative bacilli, and enterococci (for example, ampicillin and a second- or third-generation cephalosporin).[15] Antibiotic choice may need to be modified as necessary by information that localizes the infection. In the treatment of patients for whom pressure ulcers are suspected to be the source of the bacteremia, coverage should also include Pseudomonas and *B. fragilis*,[8] and may require the addition of an aminoglycoside and clindamycin or metronidazole.[15]

SUMMARY

Bacteremia has a high mortality rate in all elderly populations, but especially nursing home residents and the hospitalized elderly. Elderly patients with bacteremia may present in a nonspecific fashion with incontinence, with falls, or afebrile. Mortality is greater in patients whose bacteremia originates outside the genitourinary tract or who are bacteremic with gram-positive organisms. Early appropriate treatment has been found to reduce mortality in some studies, especially in patients over 85 years old or with gram-positive bacteremias.

Gram-negative bacteremias are more common than those caused by gram-positive organisms in most studies. *E. coli* is the most common gram-negative isolate, followed in most studies by either Proteus or Klebsiella. Staphylococcus aureus is the most common gram-positive isolate; enterococcus and pneumococcus are also frequently isolated.

Bacteremia in the elderly may present in a subtle fashion. Appropriate antibiotic therapy may reduce mortality and should include antibiotic coverage for *S. aureus* and gram-negative bacilli, as well as for anaerobes if pressure ulcers are suspected as the source. Clinicians who care for the elderly should be aware of the possible presentations of bacteremia and the appropriate treatment in all clinical settings.

REFERENCES

1. Phair JP. Host defenses in the elderly. *In* Cunha BA (ed). Infectious disease in the elderly. Chicago: Year Book Publishers, 1988.
2. Richardson JP, Knight AL. The prevention of tetanus in the elderly. Arch Intern Med. 1991;151:1712-7.
3. McCue JD. Gram-negative bacillary bacteremia in the elderly: incidence, ecology, etiology, and mortality. J Am Geriatr Soc. 1987;35:213-8.
4. Esposito AL, Gleckman RA, Cram S, Crowley M, McCabe F, Drapkin MS. Community-acquired bacteremia in the elderly: analysis of one hundred consecutive episodes. J Am Geriatr Soc. 1980;28:315-9.
5. Madden JW, Croker JR, Beynon GPJ. Septicaemia in the elderly. Postgrad Med J. 1981;57:502-6.
6. Windsor ACM. Bacteraemia in a geriatric unit. Gerontology. 1983;29:125-0.
7. Meyers BR, Sherman E, Mendelson MH, et al. Bloodstream infections in the elderly. Am J Med. 1989;86:379-84.
8. Bryan CS, Dew DE, Reynolds KL. Bacteremia associated with decubitus ulcers. Arch Intern Med. 1983;143:2093-5.
9. Setia U, Serventi I, Lorenz P. Bacteremia in a long-term care facility. Arch Intern Med. 1984;144:1633-5.
10. Rudman D, Hontanosas A, Cohen Z, Mattson DE. Clinical correlates of bacteremia in a Veterans Administration extended care facility. J Am Geriatr Soc. 1988;36:726-32.
11. Maki DG. Nosocomial bacteremia: an epidemiologic overview. Am J Med. 1918;70:719-32.
12. Aronson MD, Bor DH. Blood cultures. Ann Intern Med. 1987;106:246-53.
13. Gleckman R, Hibert D. Afebrile bacteremia. JAMA. 1982; 248:1478-81.
14. Leibovici L, Greenshtain S, Cohen O, Mor F, Wysenbeek AJ. Bacteremia in febrile patients. Arch Intern Med. 1991;151:1801-6.
15. Norman DC, Castle SC, Cantrell M. Infections in the nursing home. J Am Geriatr Soc. 1987;35:796-805.