

Group B Streptococcal Infections in Elderly Adults

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Elderly adults account for >40% of persons with invasive group B streptococcal (GBS) disease and for >50% of GBS-associated deaths in the United States. The prevalence of colonization among healthy elderly adults (~25%) is similar to that among women of childbearing age. Delineating contributions of comorbid conditions, altered integrity of anatomical barriers, and abnormalities in immune responses caused by immune senescence to pathogenesis require further investigation. Delayed clinical recognition of illness may contribute to poor outcome. Skin and soft-tissue infections and bacteremia with no identified focus are common manifestations of infection in elderly adults and younger nonpregnant adults. Urinary tract infection and pneumonia are presentations more often encountered in elderly persons than in younger adults. The safety and immunogenicity of GBS serotype V–tetanus toxoid conjugate vaccine in healthy elderly persons suggest the potential for vaccination as an approach to prevention of invasive GBS infections in elderly persons.

A few years after Lancefield [1], in 1933, described the serological classification of hemolytic streptococci into groups, invasive infections caused by *Streptococcus agalactiae* or group B *Streptococcus* (GBS) in older adults were reported. In 1940, Ranz [2] described 2 elderly adults with GBS infection, one with diabetes mellitus and septic arthritis. Invasive infections in 13 adults, including 7 who were >65 years of age, were summarized by Eickhoff et al. [3] in a 1960s review of patients with hemolytic streptococcal infections at the Boston City Hospital (Boston). Five of these adults had diabetes mellitus and gangrenous extremities. Despite these historic descriptions, most textbooks of medicine failed to list GBS as a human pathogen until the 1980s.

These early reports revealed the pathogenic potential of GBS to cause invasive disease in older individuals. Caregivers for elderly individuals know to consider the presence of GBS in patients with findings suggestive of invasive bacterial infection. Less commonly appreciated is that the burden of GBS disease among older adults is considerable and that the number of cases is increasing. In this review, we aim to discuss the epidemiology, unique aspects of pathogenesis, and clinical features of invasive GBS infection in elderly adults, as well as treatment issues and approaches to prevention.

EPIDEMIOLOGY OF GBS INFECTIONS IN ELDERLY ADULTS

Incidence of invasive infection. A 2–4-fold increase in the incidence of invasive GBS disease in adults has occurred during the past 2 decades; more than two-thirds of the cases of invasive GBS disease in the United States now occur in adults [4]. Most infections are unrelated to pregnancy, and the majority occur in adults ≥ 65 years of age. More than 50% of all deaths attributable to GBS disease now occur in elderly adults. Data from the Active Bacterial Core Surveillance (ABCs) of the Emerging Infections Program Network at the Centers for Disease Control and Prevention (CDC), which are from a surveillance population of >30 million persons, together with US Census Bureau data, are shown in table 1 [5–8]. Invasive infection was defined as isolation of GBS from blood or another usually sterile site (e.g., CSF, joint, and bone). Extrapolating from the ABCs data, there were >9000 cases of invasive GBS disease and at least 1300 GBS-related deaths among elderly persons in 2003.

Although the past 2 decades have witnessed an overall decrease in GBS-attributable case fatality rates, mortality from GBS bacteremia among nonpregnant adults remains substantial [9]. Case fatality rates for elderly adults are ~15%, notably higher than the 4%–6% reported for young infants with invasive GBS infection [5–7]. Adults ≥ 65 years of age are also at significantly greater risk of dying from GBS disease, compared with adolescents and adults 15–64 years of age [10].

Active, population-based surveillance data from the ABCs

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Table 1. Cases of invasive group B streptococcal infection (GBS) in the United States among elderly adults (age, ≥ 65 years).

Year	Estimated no. of cases among elderly persons (% of all cases)	Estimated no. of elderly persons who died (% of all GBS-related deaths)	Case-fatality rate among elderly persons, %
1997	6878 (37.2)	1059 (63.0)	15.4
2000	7873 (37.6)	1102 (53.2)	14.0
2003	9159 (40.6)	1328 (56.4)	14.5

NOTE. Data are from [5–7]. Projected total cases and deaths are estimates from [5–8]. The estimated number of cases among infants aged 0–89 days was 2500, with a case-fatality rate of 4.2% [5–7].

Emerging Infections Program Network on cases of and deaths associated with infection due to several gram-positive pathogens in 2003 are compared in table 2 [5–7, 11, 12]. The incidence of GBS disease among elderly adults (25.4 cases per 100,000 population) is lower than that of *Streptococcus pneumoniae* infection (42.2 cases per 100,000 population), but GBS accounts for a greater proportion of the pathogen-specific total disease burden (40.6% of cases) among elderly persons than either *S. pneumoniae* or group A *Streptococcus* (GAS) infections (33.3% and 31% of cases, respectively). Each of these 3 pathogens has a high case-fatality rate among elderly patients with invasive infection.

Prospective population-based surveillance of the greater metropolitan Atlanta area conducted during 1989 and 1990 revealed that the incidence of invasive GBS infection was twice as high in black adults than in white adults [13]. The incidence was particularly high among black adults >70 years of age. By the late 1990s, the difference in the incidence of GBS disease between black infants and white infants with invasive GBS infections had diminished, but it persisted in adults [10]. This disparity may relate, in part, to timely access to health care.

The annual incidence of invasive GBS infection increased per 10-year age group (beginning with persons aged 65 years) among community-dwelling elderly people [14]. For persons ≥ 85 years of age, it exceeded 30 cases per 100,000 population. Nursing home residents had a markedly greater incidence than did community-dwelling residents for all age groups studied by Henning et al. [14]. The age-adjusted annual incidence of GBS infection was 72.3 cases per 100,000 population for nursing home residents and 17.5 cases per 100,000 population for community-dwelling residents (relative risk, 4.1; $P < .001$). Nursing home residents also had a significantly higher case-fatality rate (per 100,000 population) associated with GBS disease, compared with community-dwelling residents (12.3 vs. 2.0 deaths per 100,000 population; $P < .025$).

Prevalence of GBS colonization in geriatric populations.

The first and, to our knowledge, the only assessment of GBS colonization prevalence among nursing home residents was published >20 years ago. While investigating an outbreak of

GAS infections, Kaplan et al. [15] processed rectal swab specimens for isolation of β -hemolytic streptococci. The prevalence of GBS colonization among 167 residents (median age, 84 years) was 12%.

In a contemporary cross-sectional survey of 254 community-dwelling healthy elderly men and women in Houston (mean age, 73 years), the GBS colonization rate was 22% [16]. Rectal swab specimens, initial voided urine specimens (obtained from men), and lower vaginal swab specimens (obtained from women) were processed. Capsular polysaccharide (CPS) types Ia (22.8%), III (12.3%), and V (47.3%) predominated; 12.3% of the colonizing isolates were nontypeable by means of the Lancefield serologic method [1]. Additional data are needed, especially for elderly people with medical conditions known to increase risk for invasive GBS disease. Existing data indicate that adults ≥ 65 years of age appear to be colonized with GBS at a rate similar to that for younger persons.

Serotype distribution of GBS isolates. Active, population-based surveillance identified almost 600 nonpregnant adults with invasive GBS infection; isolates from this cohort revealed that GBS serotypes Ia, III, and V accounted for more than two-thirds of cases (table 3) [4, 17, 18]. More than 25% of the subjects had invasive GBS disease caused by type V strains. The emergence of type V as the most common CPS type recovered from nonpregnant adults with invasive GBS disease was described by Blumberg et al. [19]. Population-based assessments of GBS disease in nonpregnant adults have not stratified cases by GBS serotype or by age. One 6-month multicenter study of invasive GBS infections in adults in Argentina found similar serotype distributions among 31 isolates from adults aged <70 years and adults aged ≥ 70 years, with the exception of type II, which was more frequent among younger adults [20].

Risk factors for invasive GBS disease. In the 1960s, Eickhoff et al. [3] recognized the relationship between severe peripheral vascular disease in adults with diabetes mellitus and GBS bacteremia. During the next decade, it became apparent that a number of medical conditions increased the risk for invasive infection. “The GBS behaves as an opportunistic pathogen against a background of various malignancies, diabetes

Table 2. Invasive infection due to group B streptococci (GBS) and other gram-positive pathogens among elderly adults (age, ≥65 years), 2003.

Pathogen	No. of cases among elderly persons (% of all cases)	Incidence rate among elderly persons, cases per 100,000 population	No. (%) of elderly persons who died	Case-fatality rate among elderly persons, deaths per 100,000 population
GBS	848 (40.6)	25.4	123 (14.5)	3.7
<i>Streptococcus pneumoniae</i>	1176 (33.3)	42.2	255 (21.7)	9.1
Group A streptococci	379 (31.0)	10.7	90 (23.7)	2.5

NOTE. Data are from [5–7, 11, 12]. Surveillance areas represent >30 million persons (for GBS and group A streptococci) and >25 million persons (for *S. pneumoniae*).

mellitus (particularly in patients with peripheral vascular insufficiency), corticosteroid administration, and chronic renal failure” Lerner et al. [21, p. 470] wrote in a 1977 review. In a contemporary series of 291 nonpregnant adults with invasive GBS infection, conditions potentially enhancing risk were documented in >90% [22]. After controlling for age, cirrhosis, diabetes mellitus, stroke, breast cancer, decubitus ulcer, and neurogenic bladder were associated with a risk for GBS disease.

Table 4 compares underlying conditions and risk factors among older and younger nonpregnant adults with invasive GBS infection [17, 23]. Diabetes mellitus and cancer were cited less often as underlying conditions among adults aged >64 years [17] or 70 years [23], respectively, than among younger adults. In contrast, residence in a nursing home, bedridden state, cardiac disease or congestive heart failure, and gastrointestinal disease were observed more often among elderly patients with invasive GBS disease than among younger adults. A comparison of underlying conditions in older adults with GBS disease and adults without GBS matched by age, sex, and date of hospital admission revealed no difference in the incidence of malignancy or diabetes mellitus, but a bedridden state remained a highly significant association for adults with GBS disease [23].

Vergese et al. [24] found that bacteremic GBS pneumonia was associated with health care in 6 of 7 older adults (mean age, 73 years), confirming data published 2 decades ago [25]. Gallagher and Watanakunakorn [25] noted that 13 of 28 episodes of bacteremic GBS infection in adults, most of whom were elderly, were acquired during hospitalization. Tyrrell et al. [17] found that 11 of 91 GBS cases in nonpregnant adult were health care associated. Most patients had undergone an intervention, such as cystoscopy, surgery, and intravascular or urinary catheter insertion, that could promote invasive infection.

PATHOGENESIS OF INFECTION

The pathogenesis of invasive GBS disease in elderly adults is likely to be multifactorial and is only partly elucidated. The prevalence of mucous membrane colonization with GBS at genital or lower gastrointestinal sites is not affected by increasing age [16]. As shown in figure 1, the older host colonized with

GBS faces the challenge of containing the organism at epithelial surfaces until adaptive immunity is established. The elderly debilitated person has reduced physical reserves as manifested in particular among bedridden nursing home residents. A closed institutional environment favors regular exposure to GBS through contact with health care workers, other residents, and staff when hand hygiene is deficient. Furthermore, diminished mobility often leads to decubitus ulcers and aspiration of oral contents [14, 26].

Physical factors and mechanical barriers. Altered integrity of anatomical barriers promotes invasion of GBS among colonized elderly persons with diabetes mellitus complicated by peripheral neuropathy or peripheral vascular disease following trauma, particularly to the lower extremities. Hospitalized, bedridden elderly persons who had swallowing or speech disorders had a significantly higher rate of detection of GBS in dental plaque than did elderly patients with normal oral motor function [27]. Rigorous daily oral hygiene could potentially reduce the risk of health care-associated GBS pneumonia [28]. Pharyngeal colonization also could serve as a reservoir for GBS. The prevalence of pharyngeal carriage of GBS among young

Table 3. Serotype distribution of group B streptococcal isolates from nonpregnant adults with invasive GBS infection, 1992–1999.

GBS serotype	No. (%) of subjects (n = 589)
Ia	143 (24.3)
Ib	72 (12.2)
II	70 (11.9)
III	97 (16.5)
IV	2 (0.3)
V	162 (27.5)
VI	0
VII	0
VIII	1 (0.2)
Nontypeable	42 (7.1)

NOTE. Data are from [4, 17, 18].

Table 4. Underlying conditions and risk factors among nonpregnant adults with group B streptococcal disease.

Underlying condition or risk factor	Younger adults (n = 82)	Older adults (n = 83)
Diabetes mellitus	++++	+++
Residence in a nursing home	+	++++
Bedridden state	+	++++
Malignancy	++++	+++
Cardiac disease; congestive heart failure	+	++++
Gastrointestinal disease	+	+++
Liver disease	++	+
Neurologic disorders	++	++
Skin disease	+++	+++
Respiratory disease	+	+
Renal disease	+	+
Vascular disease	+	++
Joint prosthesis	+	++

NOTE. Data are from studies by Tyrrell et al. [17], in which underlying conditions and risk factors were analyzed on the basis of age (<65 years vs. ≥65 years), and Trivalle et al. [23], which compared persons aged ≤70 years with persons aged >70 years. +++++, Most commonly observed (>20% of subjects); +++, commonly observed (>10% to 20% of subjects); ++, occasionally observed (5%–10% of subjects); +, rarely observed (<5% of subjects).

adults was 12% [29]. Among 35 elderly men (mean age, 80 years) living in a home for the aged, pharyngeal cultures performed on 34 occasions at intervals of 2 weeks yielded GBS in 24 (2%) of 1190 cases, but an association with invasive disease was not found [30].

Underlying medical conditions. The diversity of chronic underlying conditions among elderly patients with invasive GBS disease suggests that the pathogenesis of geriatric GBS infections is complex. The extent to which GBS virulence factors, such as C or other surface proteins, interact with epithelial barriers to mediate adherence or internalization and the extent to which β-hemolysin/cytolysin promotes invasion of epithelial cells are not known for elderly individuals. The inflammatory response of patients (e.g., signaling pathways and cytokine burst) has also not been assessed [31, 32].

Adults with diabetes mellitus may have multiple abnormalities of phagocyte function [33]. Persistent activation of low numbers of neutrophils in association with hyperglycemia or in the presence of glycation end products may mute the neutrophil responses [33, 34]. Neutrophils obtained from adults <65 years of age with type 2 diabetes mellitus had no intrinsic defect in phagocytosis and killing of type III GBS in vitro under baseline glycemic conditions [35]. Superoxide production was reduced during hyperglycemia by diversion of NADPH (nicotinamide adenine dinucleotide phosphate, reduced) into the polyol pathway. This effect was mitigated when GBS type III CPS-specific IgG was present in a sufficient concentration.

Immune senescence. Aging is associated with profound

dysfunction in cell-mediated immunity. The extent to which impaired T cell proliferation and reduced T cell-mediated Th1 cytokine responses may promote GBS virulence in elderly persons has not been studied. Changes in B cell function appear to have some similarities to age-related changes in T cells [36]. Wessels et al. [37] collected serum samples within 2 days after documented GBS bacteremia in 12 adults (median age, 43 years); 4 were ≥65 years of age. Serum levels of GBS CPS-specific IgG to the infecting strain were ≥3.5 μg/mL in 7 of 12 patients, suggesting that these GBS-specific antibodies were not functionally competent. However, with 1 exception, these serum samples mediated efficient opsonization, phagocytosis, and killing of the infecting strain in vitro, suggesting that these antibodies functioned adequately.

In a small cohort of healthy elderly persons, we demonstrated poor neutrophil-mediated functional activity against type V GBS associated in most subjects with low concentrations of type V CPS-specific antibodies [38]. CPS-specific IgG in serum specimens obtained from younger adults uniformly promotes opsonophagocytic killing of the CPS-containing strain if antibody levels are >1 μg/mL [39]. Four of 5 elderly subjects with type V CPS-specific IgG concentrations >1 μg/mL had serum specimens that promoted neutrophil-mediated functional activity. Healthy, GBS-colonized elderly adults were significantly more likely to carry type V than other GBS serotypes and to have low serum levels of type V CPS-specific IgG [16]. However, vaccination of healthy elderly adults with a single intramuscular dose of type V GBS CPS-tetanus toxoid (V-TT) vac-

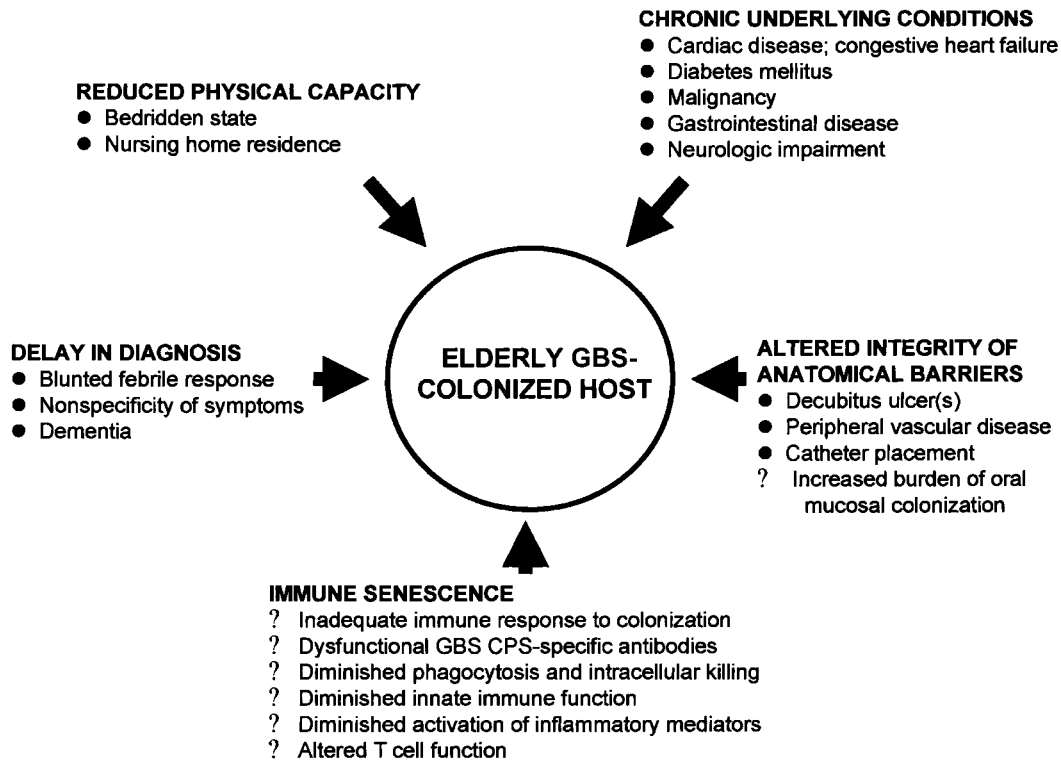


Figure 1. Proposed pathogenesis of invasive group B streptococcal (GBS) infections in elderly persons

cine induced antibodies that promoted opsonophagocytic killing of type V GBS in vitro [40]. Taken together, these findings affirm that GBS CPS-specific antibodies are functional in healthy elderly persons. The high levels of CPS-specific antibodies found during acute infection in some adults suggests that antibodies are produced rapidly in response to the antigenic stimulus or these individuals are rendered susceptible to GBS infection through defects in other components of host defense that are so severe that much higher concentrations of specific antibodies are needed to confer protection.

Delay in diagnosis. A muted inflammatory response can delay recognition of GBS invasive infection in elderly adults. Elderly persons may not communicate focal symptoms because of dementia. Furthermore, a febrile response even when bacteremia is established does not reliably occur [26]. Similarly, physical signs of meningitis, such as nuchal rigidity or a depressed level of consciousness, often are absent in older adults with meningitis, including those infected with GBS [41].

CLINICAL MANIFESTATIONS OF INVASIVE GBS INFECTION IN ELDERLY ADULTS

The frequencies with which clinical features of invasive disease occur among younger and older nonpregnant adults are summarized in table 5. Without regard to age, skin and soft-tissue infections are the most common expressions of invasive GBS

disease in adults [17, 23]. Bacteremia with no identified focus is also frequent among younger and older nonpregnant adults. Two presentations, urosepsis and pneumonia, that are common among elderly persons are infrequently reported in younger adults. The following discussion will focus on the common clinical manifestations in older persons and the features of less common manifestations that are distinctive in elderly adults.

Skin and soft-tissue infections. Cellulitis is the most frequent clinical manifestation of GBS-associated skin and soft-tissue infections. Conditions such as lymphedema, vascular insufficiency, chronic dermatitis, or radiation-induced cutaneous injury are frequently present as predisposing factors to cellulitis [4]. Patients with breast cancer who have undergone mastectomy are prone to cellulitis of the arm or chest wall as a consequence of impaired lymphatic drainage, and GBS bacteremia can occur many years after surgery [42]. Dupuy et al. [43] found that the population attributable risk of cellulitis for toe-web intertrigo was 61%. Because GBS can colonize toe webs, athlete's foot also may predispose to lower extremity GBS cellulitis [44], but specific data are lacking. Infected decubitus ulcers and, in patients with diabetes mellitus, foot ulcers are common in elderly or debilitated persons. Of 10 patients with GBS-infected decubitus ulcers described by Farley [4], 50% were nursing home residents, and 40% had dementia. Scrotal abscess or cellulitis has occurred in men with penile implants

Table 5. Clinical diagnoses for nonpregnant adults with invasive group B streptococcal infection.

Underlying condition	Younger adults (n = 82)	Older adults (n = 83)
Skin or soft-tissue infection	++++	++++
Urinary tract infection	+	++++
Pneumonia	++	+++
Bacteremia with no identified focus	+++	+++
Arthritis	+++	++
Osteomyelitis	++	+
Meningitis	+	+
Endocarditis	+	+
Peritonitis	+	+
Vascular catheter-associated infection	+	+
Postoperative infection	+	+

NOTE. Data are from studies by Tyrrell et al. [17], in which underlying conditions were analyzed on the basis of age (<65 years vs. ≥65 years), and Trivalle et al. [23], which compared persons aged ≤70 years with persons aged >70 years. +++++, Most commonly observed (>20% of subjects); +++, commonly observed (>10% to 20% of subjects); ++, occasionally observed (5%–10% of subjects); +, rarely observed (<5% of subjects).

[13]. Infections from sources as apparently benign as a paronychia and as devastating as necrotizing fasciitis have been attributed to GBS [21, 45]. Vascular device-associated infections can occur as a consequence of intravascular or arterial catheters, and these infections often are polymicrobial.

Urinary tract infections. Urinary tract infections, including pyelonephritis and prostatitis, are common in older men, especially nursing home residents [4, 42]. In one series, GBS bacteremic urinary tract infection was the most frequent diagnosis among adults >70 years of age, accounting for 13 (39.4%) of 33 cases [23]. Most of these older people had conditions predisposing to infection, including indwelling urinary catheters, a neurogenic bladder, or urologic abnormalities (e.g., obstructive uropathy due to prostatic hypertrophy). Abnormalities of urinary flow, kidney stones, chronic renal failure, and diabetes mellitus were identified as predisposing factors in a prospective study of nonpregnant adults in Spain [46].

Pneumonia. Pneumonia is a manifestation of GBS disease that occurs almost exclusively in older debilitated adults. The association of pneumonia with CNS dysfunction from dementia, neurological impairment from cardiovascular disease, or encephalopathy suggests that aspiration is an important antecedent to the development of lower respiratory involvement. In one report, 3 of 6 patients with pneumonia had CNS dysfunction, including 1 with HIV-associated encephalopathy; 3 had malignancy, including 1 with laryngeal cancer [47]. Pneumonia often is associated with health care and results in a high case-fatality rate [48]. Concomitant isolation of another organism, especially *Staphylococcus aureus*, is frequent. Chest ra-

diographs reveal lobar or multilobar infiltrates that usually are not associated with pleural reactions [42]. Lung tissue necrosis is rare [4, 48].

Bacteremia with no identified focus. Bacteremia with no evident source is the presentation of invasive GBS disease for ~15% of nonpregnant adults [17, 23]. Defective reticuloendothelial clearance during GBS bacteremia might promote these infections, because they may occur in association with chronic liver disease. Unrecognized vascular catheter-related infection could be a source of bacteremia in some patients, because coinfection with staphylococci is frequent, and both agents often are associated with health care [42]. Some elderly adults with recurrent GBS infection have had primary bacteremia with the first episode and a focal manifestation of infection, such as cellulitis or pneumonia, with the second episode [49]. Adults with GBS bacteremia should be evaluated to exclude these deep-site sources from recurrent infections, such as endocarditis or osteomyelitis.

Arthritis. Forty percent of 75 adults with GBS arthritis described by Nolla et al. [50] were ≥65 years of age. In 21 of these 30 elderly patients, arthritis was monoarticular, with cases in the knee, shoulder, and hip joints predominating. The most common predisposing factors were diabetes mellitus (7 persons), malignancy (7 persons), and chronic liver disease or cirrhosis (5 persons). One-third required open surgical debridement; some additional patients underwent daily percutaneous articular drainage. The overall mortality rate among the 30 elderly patients (20%) was higher than that among the 45 younger adults (2%).

Infections of prosthetic hip or knee joints can be caused by GBS. The interval between surgery and onset of symptoms ranged from 4 months to 10 years (mean interval, 4 years) in 14 patients (mean age, 69 years) [51]. Pain was the primary symptom. Six patients had bacteremic infection, and in several, there was a suspected focus of infection. Removal of the prosthesis usually was required to cure the infection; in 2 patients, apparent cure was achieved with antimicrobial therapy alone.

Osteomyelitis. Twelve (32%) of 37 adults for whom age was specified in the review of GBS osteomyelitis by García-Lechuz et al. [52] were ≥65 years of age. Elderly adults were less likely than younger adults to have vertebral (40% vs. 17%) or long-bone (16% vs. 0%) sites of involvement. Non-age-dependent sites of involvement included the hip bones in patients with a hip joint prosthesis and foot bones in patients with diabetes mellitus and peripheral vascular disease. Five of 12 elderly patients had bacteremia. Infection involved the hip, in 3 patients with prosthetic joints; the sternum, in 2 patients with a prosthetic heart valve; bones of the foot, in 2 patients with peripheral vascular disease; and the sacrum, in 1 patient with a decubitus ulcer. Fifteen of 30 nonpregnant adults for

whom information was specified were treated with antimicrobial therapy and surgery; in 15, medical treatment alone was employed. The mean duration of antimicrobial therapy was 10 weeks. Morbidity was substantial in the elderly patients: 2 died, 2 required amputation of a toe or foot, and 2 had relapse of infection.

Meningitis. GBS does not readily penetrate the blood-brain barrier, except in young infants. Among >5000 cases of invasive GBS disease in nonpregnant adults observed during active, population-based surveillance, only 2% had meningitis [10]. In a comprehensive review of adults with GBS meningitis, one-fourth of 64 patients were >65 years of age [53]. Comorbid conditions existed in 86%; among the 16 elderly persons, these included colon cancer, chronic urinary tract infection, and end-stage renal disease. GBS meningitis occurred spontaneously in 94% of patients, and in one-half, a distant focus of infection was found. The clinical presentation of GBS meningitis is not distinctive. The CSF is purulent (WBC count, >5000 cells/mm³), and the Gram stain reveals organisms in 84% of patients. In elderly persons, GBS meningitis often is fatal. Domingo et al. [53] cited an overall case-fatality rate of 34%, but among adults ≥65 years of age, the case-fatality rate was 56%.

Endocarditis. Eleven of 30 adults with GBS endocarditis described by Sambola et al. [54] were ≥65 years of age. Several elderly adults had underlying cardiac disease, including 2 with rheumatic heart disease, and 2 with a mechanical prosthesis. The duration of symptoms ranged from 1 to 30 days, and the common presenting clinical features were fever (8 patients), left-sided heart failure (3 patients), or stroke (3 patients). The mitral or aortic valves were most often involved. Each of the 5 patients with prosthetic valve-associated endocarditis had a fatal outcome. Among patients with native-valve endocarditis, the case-fatality rate was higher among elderly patients (45%) than among younger patients (21%). In their review of 115 cases, Sambola et al. [54] noted that the case-fatality rate has decreased in recent years, citing increased use of cardiac surgery as improving the prognosis for native-valve endocarditis caused by GBS.

Other manifestations of infection. There are several clinical settings in which GBS should be considered as a potential pathogen, particularly among elderly patients. Peritonitis occurs almost exclusively among patients with hepatic dysfunction, and it is associated with a high mortality rate. GBS should be considered as a cause of bacteremia in geriatric patients who have undergone endoscopy of the gastrointestinal tract [55]. GBS has presented as a toxic shock-like syndrome in adult patients who have necrotizing fasciitis, although this presentation is not common [56]. Finally, elderly patients who have required cataract extraction have developed postoperative endophthalmitis caused by GBS [57].

ANTIMICROBIAL THERAPY

Penicillin is the antimicrobial agent of choice for GBS infection. Of 192 clinical isolates of GBS (146 of which were from nonpregnant adults), each was susceptible to penicillin G, ampicillin, ceftriaxone, meropenem, vancomycin, and levofloxacin [58]. The estimated rates of resistance to erythromycin and clindamycin among GBS isolates are ≥20% and ≥15%, respectively. Erythromycin or clindamycin should not be employed for treatment in penicillin-allergic adults unless susceptibility of the infecting GBS isolate to these agents is documented. Because high-level resistance to gentamicin has not been detected among GBS isolates, gentamicin use for synergy with penicillin G or ampicillin in patients with life-threatening manifestations of invasive GBS infection may be undertaken without testing.

PREVENTION

A pentavalent conjugate vaccine containing GBS CPS types Ia, Ib, II, III, and V potentially could prevent >95% of the cases of invasive disease in elderly adults [18]. The only documentation of the feasibility of this approach is a phase 1 trial evaluating the safety and immunogenicity of a V-TT vaccine in 32 healthy adults 65–85 years of age who received either V-TT vaccine (22 persons) or tetanus-diphtheria toxoid (Td) vaccine (10 persons) [40]. GBS V-TT conjugate vaccine elicited CPS-specific IgG responses that peaked 4–8 weeks after vaccination and persisted at significantly elevated concentrations 1 year later. The immune response was slightly, but not significantly, diminished from the response previously reported for healthy, younger adult recipients of V-TT conjugate vaccine [59]. Serum samples obtained after vaccination from V-TT conjugate vaccine recipients, but not serum sample from Td recipients, promoted significant opsonization, phagocytosis, and killing of type V GBS in vitro. Elderly adults who responded to vaccination with the V-TT conjugate vaccine had maturation of type V CPS-specific IgG avidity.

Functional antibody activity against *S. pneumoniae* in elderly recipients of 23-valent pneumococcal polysaccharide vaccine correlated with decreased IgG antibody avidity appeared to decrease with age, and the decrease was more pronounced in adults ≥80 years of age [60]. Even if this should prove to be true for elderly persons vaccinated with GBS conjugate vaccine, extremely elderly persons represent <25% of the US elderly population. Although further studies are needed, routine administration of a suitable GBS conjugate vaccine to individuals ≥65 years of age could substantially reduce mortality and morbidity attributable to invasive GBS infections in this high-risk population.

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