Pneumococcal Bacteremia in Monroe County, New York

ABSTRACT

Objectives. Knowledge of the epidemiology of pneumococcal disease is critical for public health planning, evaluation of preventive strategies, and development of immunization recommendations.

Methods. We studied the incidence and case-fatality rates of pneumococcal bacteremia as a proxy for pneumococcal disease in Monroe County, New York, from 1985 through 1989 by reviewing the laboratory and clinical care records of all cases occurring among residents.

Results. There were 671 cases identified, for an overall yearly rate of 18.8 per 100 000. The rates were highest in the very young, in the very old, and in non-White populations. Age-specific rates were consistently higher in Blacks than in Whites. Predisposing medical conditions were present in 61% of cases. Case-fatality rates were 15% overall, 27% in those with predisposing medical conditions, and approximately 30% in Blacks older than 55 years and Whites older than 65 years.

Conclusions. This study documents the incidence of and mortality from pneumococcal bacteremia. It supports previous observations that Black populations have an increased risk of invasive pneumococcal infection and suggests that immunization should be considered for Blacks older than 55 years. (*Am J Public Health.* 1992;82:1513–1516)

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Introduction

Pneumococcal disease causes significant morbidity and mortality despite the availability of a vaccine and of antibiotic treatment. Although pneumococcal pneumonia is the most common manifestation of infection with *Streptococcus pneumoniae* in adults, its diagnosis by sputum culture is unreliable.[1–3] However, the occurrence of pneumococcal bacteremia can easily be ascertained by review of laboratory records, and rates of pneumococcal bacteremia can be extrapolated to provide a reasonable estimate of the extent of pneumococcal disease in a community. Approximately one half of pneumococcal bacteremias are thought to be secondary to pneumonia, and about one fifth of episodes of pneumococcal pneumonia are complicated by bacteremia.[4] The prevention of pneumococcal disease and the development of immunization guidelines depend on a complete understanding of the disease's epidemiology.

Previous studies of pneumococcal bacteremia (Table 1) have been based on relatively small populations and numbers of cases, and have reported widely divergent rates.[5–9] Two studies done by the Centers for Disease Control in Charleston County, South Carolina,[5,9] showed a doubling of rates from the 1970s to the 1980s associated with an increase in the number of blood cultures drawn in the 1980s.[9] Previous studies have documented higher rates of pneumococcal bacteremia in non-White populations, in the very young, and in the very old.[5–9]

The extent of mortality due to all pneumococcal disease is also not known. Pneumonia is a leading cause of death in the elderly, and pneumococcal pneumonia constitutes at least 15% of community-acquired pneumonias.[4,10] Overall case-fatality rates for pneumococcal bacteremia remain at 17% to 19% despite appropriate antimicrobial therapy, and they are higher in the elderly and in those with comorbid conditions.[4,9] To guide immunization policies, it is important to understand the pattern of mortality in different groups of patients.

To clarify the epidemiology of pneumococcal disease, we studied the incidence and case-fatality rates for pneumococcal bacteremia in Monroe County, New York, from 1985 through 1989. We also ascertained comorbid conditions in patients requiring hospitalization.

Methods

Monroe County, located in western New York, had a total estimated population of 712 695 in 1985. The county centers on Rochester and includes urban, suburban, and semirural populations. The age and race population distribution of Monroe County is similar to that of the United States, with 85% White, 10% Black, and 5% Hispanic and other groups. There are eight hospitals in the county and all microbiology specimens

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This paper was submitted to the Journal April 29, 1991, and accepted with revisions May 22, 1992.

TABLE 1—Previously Reported Rates of Pneumococcal Bacteremia

Study Author (Period of Study)	Location of Population	No. Cases	Crude Annual Incidence Rates (per 100 000)
Filice[5] (1974–1976)	Charleston County, South Carolina	62	8.5
Mufson[6] (1978–1981)	Huntington, West Virginia	53	7.5
Davidson[7] (1980–1986)	Alaskan Natives	114	105.0
Istre[8] (1984)	Oklahoma City, Oklahoma	128	15.1
Breiman[9] (1986–1987)	Charleston County, South Carolina	110	18.7

TABLE 2—Annual Incidence of Pneumococcal Bacteremia by Age and Race, Monroe County, New York, 1985 through 1989

	No. Cases	County Population, 1985 Projections	Incidence (per 100 000)
Age, y			
<1	95	10 835	175.4
1–4	128	38 416	66.6
5–19	21	144 370	2.9
20–54	118	356 839	6.6
55–64	68	76 577	17.8
65+	241	85 658	56.3
Total	671	712 695	18.8
Race			
White	418	607 493	13.8
Black	175	71 061	49.3
Hispanic	27	21 667	24.9
Asian	6	5 702	21.0

are processed in six laboratories. Patients from the surrounding rural counties are often admitted to hospitals in Rochester, but few residents of Monroe County seek medical care outside the county.

We defined incident cases as episodes of pneumococcal bacteremia occurring during the 5 years of the study. We searched the records of the six clinical microbiology laboratories. Care was taken to count cases and not isolates, because there were often several positive blood cultures from each patient.

Each patient's chart was reviewed for zip code to establish residence in the county and for age, sex, race, comorbid conditions predisposing to pneumococcal bacteremia, and outcome (survival or death). Zip code, age, race, and sex were determined from the face sheet of the patient's admission chart or from the emergency room or outpatient record when the patient was not admitted to the hospital. Comorbid conditions were available only for those patients admitted to hospital and were determined from the discharge report. Because this study was based on retrospective chart review, we were not able to obtain accurate pneumococcal vaccination histories.

Crude and specific incidence density rates were calculated[11] using Monroe County population estimates for 1985.[12] Case-fatality rates were calculated by dividing the number of deaths by the number of cases within each stratum.

We performed chi-square tests to compare incidence rates and case fatality rates in Blacks with those in Whites within each age stratum. We calculated rate ratios with 95% confidence intervals (CI) to estimate the strength of the association between race and pneumococcal bacteremia within each age stratum. The effects of age, race, and number of comorbid conditions on outcome were analyzed by multiple linear regression.

Results

This study is based on 671 cases. A total of 812 cases of pneumococcal bacteremia occurred in Monroe County during the 5-year period of the study, but these included 41 patients (5%) for whom no record could be located and who were therefore not included in this study. Of the 771 patients for whom a clinical record was available, 98 (13%) resided outside Monroe County and the charts of 2 contained insufficient information. Race or ethnic background data were available for 93% of the cases. Therefore, overall and age-specific incidence rates are based on 671 cases, but race-specific rates are based on only 626 cases.

The overall annual incidence rate of pneumococcal bacteremia was 18.8 per 100 000 (Table 2). The yearly incidence did not vary significantly during the 5 years of the study. Age-specific incidence rates ranged from 2.9 per 100 000 in those aged 5 through 19 years to 175.4 per 100 000 in infants younger than 12 months. The rates were highest at the extremes of age and were considerably lower in those aged 55 through 64 years than in those aged 65 years and older. The incidence of pneumococcal bacteremia was markedly higher in non-White populations (Table 2).

To clarify the role of age distribution in the racial difference, we compared Black and White age-specific rates of bacteremia (Table 3). The differences in rates were highly statistically significant within each age stratum; rate ratios ranged from 2.7 in those aged 65 years and older to 7.9 in those aged 1 through 4 years. The incidence rate in Blacks aged 55 through 64 years was higher than that in Whites aged 65 years and older, but the difference was not statistically significant.

The overall admission rate for cases of pneumococcal bacteremia was 69.6% (467/671). This rate ranged from 17.2% (22/128) in children aged 1 through 4 years to 99.6% (240/241) in those aged 65 years and older. Although the overall rate of admission was somewhat higher among Whites, age-specific rates of admission did not differ between Blacks and Whites. Of the 467 patients who were admitted, the records of 23 (4.9%) did not include accurate information regarding comorbid conditions. Therefore, our tabulation of conditions predisposing to pneumococcal bacteremia is based on the 444 hospitalized patients with pneumococcal bacteremia for whom medical records were complete. Of these, 175 (39.4%) had no comorbid conditions. The frequency of

one or more comorbid illnesses increased with age but differed little between Black and White cases (Table 4). The most common comorbid illnesses were congestive heart failure (16%), chronic obstructive pulmonary disease (16%), and diabetes mellitus (13%). Alcohol abuse was noted in 5% of Whites and in 25% of Blacks. Of the 45 patients with a documented history of alcohol abuse, 14 had liver disease. Four children had sickle cell anemia (Hb SS) (a prevalence rate of 4%). One child had Hb SC disease. Eleven men, aged 28 through 62 years, had acquired immunodeficiency syndrome (AIDS).

At least one indication for pneumococcal immunization was present in 81% of the White patients and 64% of the Black patients. About 50% of both Black and White patients younger than 65 years had an indication for immunization. In those 55 through 64 years old, the rate of comorbid predisposing medical conditions was no higher than that among those aged 65 years and older and was the same for Blacks and Whites.

The overall case-fatality rate was 15% (n = 102), but the rate was 30% (n = 70) in those aged 65 years and older (Table 5) and only 2% in those younger than 5 years. The case-fatality rate was 13% among patients with no comorbid conditions and 27% in those with predisposing conditions. The only racial difference in the age-specific case-fatality rates was in those 55 through 64 years old. The case-fatality rate was markedly higher in Blacks in this age group, but this difference failed to reach statistical significance (Fisher exact $P = .099$). Multiple linear regression confirmed the independent and significant effects of age ($P = .003$) and number of comorbid conditions ($P = .03$) and the lack of effect of race ($P = .54$) on outcome.

TABLE 3—Incidence Rates of Pneumococcal Bacteremia in Blacks vs Whites, Monroe County, New York, 1985 through 1989

Age, y	Incidence (per 100 000) Black	White[a]	Rate Ratio[b]	95% CI of Rate Ratio
<1	478.54	144.86	3.3	2.1, 5.2
1–4	197.01	25.02	7.9	5.2, 11.9
5–19	5.62	1.00	5.6	2.0, 16.0
20–54	26.31	3.96	6.6	4.5, 9.8
55–64	67.55	18.12	3.7	2.0, 7.0
65+	161.85	58.98	2.7	1.2, 6.7
Total	49.25	13.76	3.6	3.0, 4.3

[a]$P < .005$ for comparison of frequencies.
[b]Rate ratio = incidence in Blacks/incidence in Whites.

TABLE 4—Presence of Comorbid, Predisposing Medical Conditions in Patients with Pneumococcal Bacteremia, by Age and Race, Monroe County, New York, 1985 through 1989[a]

Age, y	Black Patients %	Black Patients n	White Patients %	White Patients n	All Patients %	All Patients n
<1	11	1	7	1	11	3
1–4	27	4	40	2	29	6
5–19	25	1	33	1	33	3
20–54	74	29	48	25	58	57
55–64	67	8	67	35	67	43
65+	71	15	69	141	70	157
Total	58	58	62	205	61	269

[a]Underlying medical conditions include acquired immunodeficiency syndrome (AIDS), asplenia (functional and anatomic), dysglobulinemia, drug-induced immunosuppression, hematologic malignancy, metastatic carcinoma, nephrotic syndrome, renal transplantation, systemic lupus erythematosus, alcoholism and alcohol abuse, cerebrovascular accident, chronic liver disease, chronic pulmonary disease, chronic renal failure with dialysis, congestive heart failure, dementia, diabetes mellitus.

TABLE 5—Case Fatality Rates by Age and Race, Monroe County, New York, 1985 through 1989

Age, y	Black %	Black n	White %	White n	Total %	Total n
<1	3	1	0		2	2[a]
1–4	4	2	3	1	2	3
5–19	0		0		0	
20–54	16	7	15	9	16	16
55–64	33	4	13	7	16	11
65+	24	5	30	64	30	70[a]
Total	11	19	19	81	15	102

[a]Includes one Hispanic.

Discussion

This case series includes more cases than any previous study and therefore is likely to yield more reliable estimates of incidence rates and case-fatality rates. It is striking that our findings so closely replicate those of the smaller 1986 to 1987 Charleston County study.[9] These studies, taken together, provide useful baseline incidence rates of pneumococcal bacteremia. However, they may represent underestimates, as suggested by Austrian.[13] Although passive prospective surveillance in Connecticut indicates that rates may be somewhat higher, that study is not community based and therefore does not allow for the calculation of incidence rates (E. D. Shapiro, MD, personal communication, December 11, 1990).

There are several sources of possible underestimation of incidence rates in the present study. First, our rates are clearly dependent on the isolation of *S. pneumoniae* from blood cultures and therefore on the obtaining of blood cultures in appropriate clinical settings and before the administration of antimicrobials. The incidence among institutionalized elderly populations may be underestimated if laboratory access is limited.

Second, we were unable to obtain all patient records for the identified pneumococcal isolates. Because we were missing only 41 charts and at least 13% of them would be expected to be non–Monroe County residents, these missing charts represent only 36 cases, or 7 cases per year. It is unlikely that so few cases would markedly affect the results.

Third, if residents of Monroe County had pneumococcal bacteremia when they were outside the county, our rates would represent underestimates of the incidence of pneumococcal disease. However, it is unlikely that many Monroe County residents would be hospitalized in the surrounding rural counties or that they would travel to Buffalo or Syracuse for treatment of pneumococcal bacteremia.

This study confirms the previously reported higher incidence of pneumococcal bacteremia in Black populations. In addition, the large size of our study population enabled us to show statistically significant higher rates in Blacks in all age groups. Our data suggest that other minority populations may also have an increased incidence.

The reasons for higher rates of pneumococcal bacteremia in non-White populations are not known. It is possible that higher apparent rates result from more frequent blood culturing or more frequent hospitalization and consequent blood culturing. However, if this were the case we might expect Black patients to have a lower case-fatality rate, because increased blood culturing and hospitalization might identify Black patients who were less ill than White patients. Our data give no indication of selective identification of milder cases in Black patients.

Another possible source of the difference in rates in non-White populations is census undercounting. However, we believe that it is unlikely that census inaccuracies could account for rate ratios that range from 2.7 to 7.9.

Other possible explanations include differences in access to medical care, resulting in more frequent progression of disease to bacteremia in Blacks; socioeconomic status; crowding; clustering of cases within neighborhoods; association with underlying medical conditions; and the relative rates of pneumococcal vaccination or other immunologic differences. In the CDC study of Charleston County reported in 1990, controlling for socioeconomic status by census tract income data failed to remove the effect of race on incidence rates.[9] In our study, the frequency of underlying medical conditions known to increase susceptibility to pneumococcal disease did not differ between Blacks and Whites (58% vs 62%).

If the higher rates of pneumococcal bacteremia in Blacks cannot be ascribed to methodological problems, this study will add to the growing body of literature that documents the poorer health status of Black Americans.[14,15] Future studies must identify the specific environmental or biologic factors responsible for the increased morbidity and mortality in Black populations. One limitation of this study is the lack of data regarding the vaccination status of patients. It is critical that future studies be prospective so that hypotheses regarding the causes of the difference in incidence rates can be tested with accurate data.

In conclusion, pneumococcal bacteremia remains a serious public health problem with particularly high incidence in the very young and the very old. Given its high case-fatality rate, especially in the elderly, primary prevention strategies must be implemented in populations at high risk. The need for a conjugate vaccine in children cannot be overemphasized. Recent studies have confirmed the effectiveness of the current pneumococcal vaccine,[16] but debate continues regarding the indications for its use.[17] If studies confirm the markedly increased incidence and possibly increased case-fatality rate in Black populations over the age of 55, this group should perhaps be added to the growing list of those for whom vaccination is indicated.[17] The finding that age has a significant effect on the efficacy of vaccination[16] further supports lowering the age to 55 in this high-risk population. Given the evolving recommendations regarding immunization practices,[18] physicians and public health workers must improve the rates of immunization in targeted populations to reduce the morbidity and mortality documented by this study. □

Acknowledgments

The authors gratefully acknowledge the extensive assistance of Jacqueline Wendel, Systems Manager, in using the CLINFO Data Analysis System of the University of Rochester (which is supported by the Division of Research Resources of the National Institute of Health [GCR RR 00044]).

These data were presented in part at the national meeting of the American Federation of Clinical Research, Washington, DC, May 4–7, 1990.

We thank all the directors of the clinical laboratories and the medical record departments of Monroe County for their assistance in gathering data and Mary Mastroianni for her help in manuscript preparation.

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