Seasonality of Bacteremic Streptococcus pneumoniae Community-Acquired Pneumonia (CAP)

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ABSTRACT

Introduction
Streptococcus pneumoniae (Sp) is an important etiology of CAP (SpCAP). The literature suggests that a viral infection such as influenza may predispose patients to more severe forms of SpCAP, associated with hospitalization and bacteremia. If patients infected with Sp and influenza would be predisposed to Sp bacteremia, we would expect the incidence of Sp bacteremia to change according to the season of the year.
The objective of this study was to evaluate the incidence of patients admitted to the hospital with SpCAP and bacteremia according to the season of admission.
Methods
This was a secondary data analysis of the Community-Acquired Pneumonia Organization (CAPO) International Cohort Study database. Patients hospitalized with SpCAP were evaluated for the presence of bacteremia during summer, fall, winter, and spring. The Chi-squared test was used to evaluate statistical differences in the incidence of SpCAP bacteremia between seasons.
Results
A total of 4,507 hospitalized patients with CAP were evaluated, and 425 (9%) had SpCAP bacteremia. The incidence of SpCAP bacteremia by season was as follows; summer, 9%; fall, 26%; winter, 36%; spring, 29% (P<0.001).
Conclusions
This study indicates that bacteremic SpCAP is more frequent in the winter season. Our data support several studies using animal models, indicating that influenza favors invasiveness of Sp and may be conducive to more episodes of bacteremia.

INTRODUCTION

Community-acquired pneumonia (CAP) is one of the most common cause of high morbidity & mortality around the globe affecting the quality of life and cost of living[3,9,10] . It occurs year round in all ages. WHO states that in Europe and the USA *Streptococcus pneumoniae* (Sp) is the most common cause of CAP, in these regions each year about 10 to 100 cases of pneumonia occur in every 100,000 people[10]. CDC's records show that 900,000 Americans get pneumonia each year, about 400,000 hospitalizations are due to pneumococcal pneumonia, 36% of adult Sp CAP is due to pneumococci, 25–30% of patients with Sp CAP get bacteremia and 5-7% die from it[9]. It also states that pneumococcal infections show a seasonal pattern in rise and fall of occurrence in the USA with increased prevalence in winter months, which tends to decrease in summer[9]. It has also been reported that the seasonal variation of bacteremic pneumococcal pneumonia correlates with the timing of high influenza activity[5,6,8] and respiratory syncytial virus[5]. Viral infection affects lung function in various ways and alters the pulmonary immune mechanism rendering them vulnerable to bacterial invasion and increasing the severity of disease [3, 4]. This literature suggests that a viral infection such as influenza may increase the susceptibility of patients to more severe forms of Sp CAP, associated with hospitalization and bacteremia[7]. If patients suffering from Sp and influenza are more likely to have Sp bacteremia, it is expected that the incidence of Sp bacteremia should also change with the season. The objective of this study was to evaluate the incidence of patients admitted to the hospital with SpCAP and bacteremia according to the season of admission.

METHODS

Study Design and Study Population:
This was a secondary analysis of patients enrolled in the Community-Acquired Pneumonia Organization (CAPO) international cohort study. Data was collected between 2001 and 2015. In each participating center, non-consecutive medical records of hospitalized patients with the diagnosis of CAP were reviewed. A sample of the data collection form is available at the study website (www.caposite.com). Validation of data quality was performed at the study center before the case was entered in to the CAPO database. Institutional Review Board approval was obtained by each participating center.

Study Definitions:
Inclusion criteria

- *CAP*: Diagnosis of CAP required the presence of criterion A, B, and C:

A. New pulmonary infiltrate on imaging (CT scan or chest x-ray) at the time of admission to the hospital.
B. Signs and Symptoms of CAP (at least one of the following)
1. New or increased cough (per the patient)
2. Fever >37.8° C (100.0° F) or hypothermia <35.6° C (96.0° F).
3. Changes in WBC (leukocytosis >11,000 cells/mm^3, left shift > 10% band forms/microliter, or leukopenia < 4,000 cells/mm^3
C. Working diagnosis of CAP at the time of hospital admission with antimicrobial therapy given within 24 hours of admission.

- Patients in whom blood cultures were obtained

Exclusion Criterion:
- Residence in tropics (Puerto Rico, Venezuela, Philippines)

Patients hospitalized with Sp CAP were evaluated for the presence of bacteremia during summer, fall, winter, and spring.

Meteorological Seasons:
- Northern Hemisphere
  - Winter = December, January, February
  - Spring = March, April, May
  - Summer = June, July, August
  - Fall = September, October, November
- Southern Hemisphere is the opposite
  - Summer/Winter switch and Fall/Spring switch

Statistical Analysis:
The Chi-squared test was used to evaluate statistical differences in the incidence of Sp CAP bacteremia between seasons.

RESULTS

- A total of 4,507 hospitalized patients with CAP were evaluated, and 425 (9%) had SpCAP bacteremia.
- The number of patients admitted with CAP by season is shown in Figure 1.
- The number of patients with bacteremic SpCAP by season is shown in Figure 2.

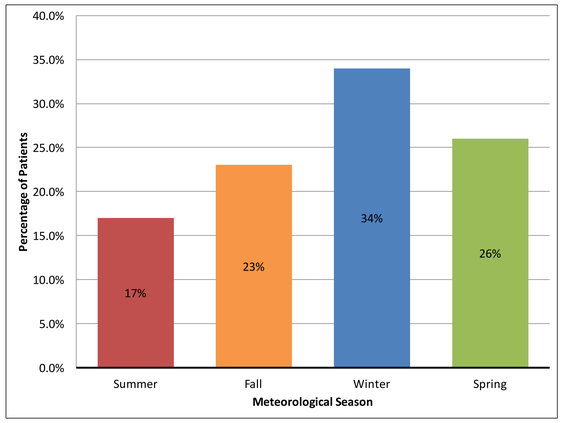

Fig: 1 Percent of cases with *S. pneumoniae* by season of admission

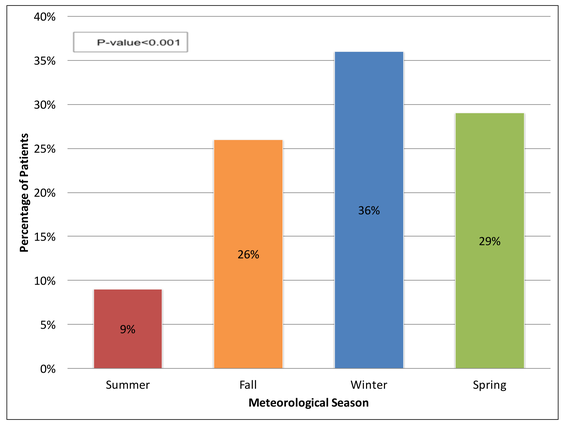

Fig: 2 Percent of cases with *S. pneumoniae bacteremia* by season of admission

CONCLUSIONS

This study indicates that bacteremic Sp CAP is more frequent in the winter season. Our finding is backed by the data from other studies, which have also reported seasonal variations and the correlation with the period of high influenza activity[5, 8]. Our data also supports several other studies using animal models, indicating that influenza favors invasiveness of Sp and may be conducive to more episodes of bacteremia[6]. It has been established that influenza virus causes damage of pulmonary vascular epithelial cells leading to microvascular leak [1], upregulates bacterial receptors, enhances adherence & invasion of Sp bacteria, decreases pulmonary bacterial clearance, alters immune response and amplifies inflammatory reactions [3,4] . Pneumococcal and influenza vaccination has been reported to have decreased the incidence of the SpCAP and the bacteremia [2,4,10]. Studies towards finding the effective way of controlling viral infections and vaccines that cover multiple strains may be a way of approach.

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