Mortality From Acute Pulmonary Embolism According to Season*

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Background: Varying observations have been made on seasonal differences of mortality from acute pulmonary embolism (PE).

Methods: The number of deaths each year from PE, from 1980 through 1998, based on death certificates, was obtained from the US National Center for Health Statistics Multiple Cause-of-Death Files.

Results: Acute PE as the cause of death ranged from 0.91 to 1.03 PE deaths per quarter per 100,000 population. Small differences were statistically significant due to the large number of patients evaluated. Quarterly mortality rates from PE in the northeast, south, midwest, and west, where seasonal weather varies widely, showed no meaningful seasonal differences.

Conclusion: Mortality rates from PE do not vary to a meaningful extent according to season.

Key words: pulmonary embolism; venous thromboembolism

Abbreviation: PE = pulmonary embolism

Varying observations have been reported on seasonal differences of mortality from acute pulmonary embolism (PE). Several investigators1–5 reported peak mortality rates in the first quarter of the year, sometimes with overlap in the last quarter,6 and sometimes with second peaks in the third quarter.1,2 Others7–9 reported peak mortality rates in the second quarter, sometimes with second peaks in the third and fourth quarter,7 or fourth quarter alone.8 And still others10 reported peaks only in the third and fourth quarters. More frequent fatal PE during “fine weather phases” of the year and “at the beginning of fine weather” has been reported.11 No reported quarterly variation has also been reported.12,13 Many of these investigations1–3,5,6 were based on observations in < 200 patients. The largest investigation included < 1,500 patients.11 We report data from the US National Center for Health Statistics, which includes an order of magnitude more data than has previously been published.

Materials and Methods

The number of deaths each year from PE, based on death certificates, was obtained from the US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Multiple Cause-of-Death Files.14 Data were available from 1980 through 1998. During those years, deaths were coded with the International Classification of Diseases, Ninth Revision, Clinical Modification, for identification of patients with PE (codes 415.1, 634.6, 635.6, 636.6, 637.6, 638.6, and 673.2).

The average quarterly mortality rate of PE over an interval of 18 years was calculated by dividing the 18-year quarterly sum of patients whose death certificates listed PE as the cause of death by the 18-year sum of the yearly populations. The population estimates were derived from the US Bureau of the Census estimates of national and state resident populations.15 States comprising regions of the United States, as defined by the National Hospital Discharge Survey, were described previously.16 Two-way analysis of variance (regions by seasons) was calculated using software (SPSS version 13.0; SPSS; Chicago, IL).

Results

Acute PE as the cause of death at autopsy was reported on death certificates in 184,201 patients from 1980 through 1998. Quarterly mortality rates throughout the entire United States ranged from 0.91 to 1.03 PE deaths per quarter per 100,000
population (Table 1). Seasonal and regional mortality rates from PE were evaluated and are presented in Table 1. There was an overall significant difference in mortality for the four seasons and four regions. There was no significant interaction for regions by seasons. All were within one PE death per quarter per 100,000 population. Small differences were statistically significant due to the large number of patients evaluated.

**Discussion**

The diagnosis of fatal PE based on death certificates should be used with caution to study the epidemiology of PE because of inaccuracies. Recognizing this, we assume that whatever inaccuracy exists in the death certificates is constant throughout the seasons.

We previously reported no quarterly (seasonal) differences in the rate of diagnosis of PE among hospitalized patients. The results of that investigation and the present investigation were strengthened by evaluations of regions of the United States, which have widely varying weather conditions. Rates of diagnosis of PE, deep venous thrombosis, and venous thromboembolism and mortality rates are lower in the western region than in other regions. The reason is unclear. Although the population is somewhat younger in the western region, differences were shown among patients ≥65 years of age. Also, although there are more Asian Americans in the western region, and the Asian population has lower rates of venous thromboembolism, the western region also had lower rates of diagnosis and lower mortality rates among whites and blacks. None of the regions showed meaningful quarterly (seasonal) differences in the rate of diagnosis or mortality rate from PE. This investigation reports data on many thousands of patients. Although there was a trace higher mortality rate in January to March, such differences were ≤1 PE death/quarter/100,000 population. Such differences would not be observable in studies of only a few hundred patients. The absence of meaningful seasonal variation in mortality from PE shown in this investigation, and the absence of seasonal variation of the rate of diagnosis in hospitalized patients, shown previously, indicate that PE is not affected by the season, contrary to reports based on smaller investigations.

**Table 1**—Average Quarterly Rate of Deaths From PE, 1980–1998 (PE Deaths/100,000 Population)

<table>
<thead>
<tr>
<th>Region*</th>
<th>January–March</th>
<th>April–June</th>
<th>July–September</th>
<th>October–December</th>
<th>All Seasons†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>1.11</td>
<td>0.98</td>
<td>0.97</td>
<td>1.03</td>
<td>1.02</td>
</tr>
<tr>
<td>Midwest</td>
<td>1.14</td>
<td>1.00</td>
<td>0.99</td>
<td>1.06</td>
<td>1.05</td>
</tr>
<tr>
<td>South</td>
<td>1.22</td>
<td>1.06</td>
<td>1.09</td>
<td>1.16</td>
<td>1.13</td>
</tr>
<tr>
<td>West</td>
<td>0.65</td>
<td>0.69</td>
<td>0.60</td>
<td>0.65</td>
<td>0.62</td>
</tr>
<tr>
<td>All regions</td>
<td>1.03</td>
<td>0.91</td>
<td>0.91</td>
<td>0.98</td>
<td>0.96</td>
</tr>
</tbody>
</table>

* Differences between regions: south greater than northeast, midwest, and west (p < 0.05); northeast and midwest greater than west (p < 0.05).
† Differences between seasons: January to March greater than April to June, July to September, and October to December (p < 0.05); October to December greater than April to June, and July to September (p < 0.05).

**References**

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