



Regular Article

Time trends in pulmonary embolism mortality in France, 2000–2010



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ARTICLE INFO

Article history:

Received 12 August 2014

Received in revised form 26 November 2014

Accepted 1 December 2014

Available online 5 December 2014

Keywords:

Cause of death

Epidemiology

France

Mortality

Pulmonary Embolism

ABSTRACT

Background: Pulmonary Embolism (PE) is a potentially fatal complication of venous thrombosis. Recent and comprehensive estimates of PE incidence and mortality are scarce. Moreover, while contemporary mortality trends of PE would enable the evaluation of prevention and quality of care, such data are lacking. The aim of this study was to provide nationwide estimations of PE mortality and time trends in France between 2000 and 2010.

Methods: Mortality data were obtained from the French Epidemiology Center on medical causes of death. Mortality rates were calculated with PE as an underlying or one of multiple causes of death. The annual percentage changes were assessed using a Poisson regression model. Age-standardized PE mortality rates were also assessed.

Results: In 2010, the overall age-adjusted PE mortality rate was 21.0 per 100000. This rate was 30% higher in men than in women and decreased by 3% per year between 2000 and 2010. Over this period, PE mortality declined in men and women over 55 years but only slightly decreased in patients younger than 55. Cancer, obesity, osteopathies and complications of surgery were often coded as the underlying causes of death when PE was an associated cause of death recorded on certificate.

Discussion: This study is the first to provide a contemporary and exhaustive nationwide estimation of PE mortality and time trends in France. The observed decrease in PE mortality between 2000 and 2010 is encouraging, but further efforts in prevention are needed to ensure that this reduction is widespread in all age groups.

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Introduction

Pulmonary embolism (PE) is one manifestation of venous thromboembolism (VTE) and is a frequent, recurrent and potentially fatal disease [1,2]. The estimated annual incidence of PE in France was 60 per 100 000 in 1998 [3]. PE contributes to 5–10% of deaths in hospitalized patients and VTE is a leading preventable cause of in-hospital death [4,5]. However, PE mortality rates are difficult to estimate because of the presence of associated comorbidity and because of the large proportion of undiagnosed PE [6].

Recent data regarding PE mortality are scarce and estimates vary considerably depending on whether the underlying cause of death or whether all comorbid conditions were considered. Studies using only the underlying cause of death dramatically underestimate the full burden of PE [7]. In United States, Horlander et al., using multiple

cause mortality, have estimated that PE mortality has decreased about 30% in 20 years reaching 9.4 deaths per 100 000 in 1998 [8]. One international study showed significant differences in PE mortality rates between European countries from 1979 to 2004 [9]. While a decrease in PE mortality overtime was described in most of the countries studied, the authors observed an increase in Germany and Poland and no clear change in the Netherlands. More recently, an epidemiological model was constructed to estimate the complete burden of VTE in Europe [10]. An estimated total of more than 370 000 VTE-related deaths across six European countries, including France, in 2004 showed the high burden of VTE in Europe.

All the available data regarding PE mortality and time trends were based on outdated diagnostic methods and hospital practices or result from an epidemiological model and were not detailed by country. Moreover, in most of studies investigating PE mortality, causes of death were coded according to the 9th revisions of the International Statistical Classification of Diseases and related health Problems (ICD-9).

In this context, the aims of the present study were to estimate the number of death caused by PE in France in 2010 and to investigate temporal PE mortality trends according to age and sex between 2000 and 2010.

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Methods

Data Source

Mortality data were obtained from the French Epidemiology Center on medical causes of death (CépiDc, Inserm). CépiDc collects and codes the two-part medical certificates for all deaths occurring in France. In the first part of the certificate, a physician records the underlying cause of death defined as the 'disease that initiated the train of morbid events leading directly to death'. The sequence of direct causal death is also completed in this part. In the second part, the physician can list all other conditions or diseases 'contributing to the death, but not related to the disease or condition causing it'. Coding rules of the ICD-10 select the underlying cause of death. Associated causes of death are all other significant conditions that contributed to it. Analyses were performed on all deaths from 2000 to 2010 occurring in people residing and deceased in France for whom PE was recorded as the underlying cause of death or was recorded on the death certificate as an associated cause of death. PE was considered to be one of the multiple causes of death if it was mentioned in the certificate either as the underlying or associated cause of death. The ICD-10 codes used for PE are I26.0 (pulmonary embolism with mention of acute cor pulmonale) and I26.9 (pulmonary embolism without mention of acute cor pulmonale).

Population data were provided by the French National Institute for Statistics and Economic Studies (INSEE).

Statistical Analysis

PE mortality rates were calculated both with PE as the underlying cause of death and as one of the multiple causes of death according to sex and age categories. Age-standardized rates were estimated using the direct method by applying the 5-year age specific mortality rates to the age structure of the 2010 European standard population. The CMF (Comparative Morbidity Figure) and its confidence interval were estimated to compare standardized mortality rates between men and women.

The analyses of time trends were performed by calculating the annual percent change in PE mortality rate by age and sex categories using Poisson regression model. Gender differences in each age category were tested by searching an interaction between these two variables.

To establish the contribution of multiple cause analysis we calculated the ratio between deaths where PE was recorded as one of the multiple causes and deaths where PE was recorded as the underlying cause of death.

We also calculated an age-adjusted relative risk (RRa) using a Poisson model by comparing frequency of underlying causes of death when PE was reported as associated cause to the frequency of deaths without PE. In order to have sufficient statistical power, the deaths occurred during the years 2008, 2009 and 2010 were grouped. This RRa allowed us to find out whether other specific causes of deaths were frequently reported on death certificate. The most frequent underlying causes of death when PE was reported as an associated cause were described by gender.

All analyses were performed with SAS enterprise Guide software version 4.3 (SAS Institute INC, Cary, NC).

Results

Burden of PE-related Mortality in France in 2010

In 2010, PE was reported as the underlying cause of death in 4 289 deaths (1 731 men and 2 558 women) in the French population (Table 1). The number of deaths rose to 13 020 (5 665 men and 7 355 women) when PE was considered as one of the multiple causes. The multiple to underlying cause of death ratio therefore was 3.0 and was higher in men than in women (3.3 vs. 2.9). This ratio did not change

during the study period (data not shown). The number of death with PE rose exponentially with age. Subjects of 85 years or more represented approximately 70% of deaths by PE.

In France, the contribution of PE to overall mortality was 2.4% in 2010 when considered as the one of the multiple causes of death. It was significantly higher in women than in men (2.8% vs. 2.1%).

Mean age at death was higher in women than in men both when PE was considered as the underlying cause of death and as one of the multiple causes (80.4 vs. 74.9 years and 80.0 vs. 74.3 years, respectively).

The crude death rate for PE as the underlying cause of death was 6.6/100 000 and was lower in men than in women (5.5 vs. 7.7/100 000). Nevertheless, after adjustment for age, death rates were not significantly different between men and women (7.2 vs. 6.5/100 000). Overall age standardized rate was 6.9/100 000.

The crude death rate rose to 20.1/100 000 when PE was considered as one of the multiple causes of death (18.1/100 000 in men and 22.0/100 000 in women). The overall age-standardized rate was 21.0/100 000 and was significantly higher in men than in women (23.4 vs. 19.0/100 000).

Evolution of PE Mortality in France According to Sex

Fig. 1 shows the gender specific and overall trends of age-standardized death from PE when considered one of the multiple causes between 2000 and 2010. The overall PE mortality rates have significantly decreased from 30.3/100 000 in 2000 to 21.0/100 000 in 2010. This rate decreased annually of 3.1% in men and of 3.0% in women from 34.1 and 27.2/100 000 in 2000 to 23.4 and 19.0/100 000 in 2010 respectively. The age standardized mortality rate was 30% higher in men than in women during the study period.

Gender-specific Evolution of PE Mortality in France According to Age

The mean annual gender specific evolution of specific mortality rate between 2000 and 2010 by 10-year age categories are shown in Fig. 2. The mean annual decrease in the mortality rate was significant among men and women aged 35–44 and those over 54 years old. The annual decrease was about 4% per year in men and women over 65. A non-significant increase in PE mortality was observed in women aged 25–34. Except for this latter age category, the trend between 2000 and 2010 is quite similar among men and women. The mortality rate was stable between 2000 and 2010 for those under 35.

Multiple Cause Analysis

The Table 2 compares the underlying causes of death when PE was listed as an associated cause of death and when it was not. Between 2008 and 2010, osteopathies and chondroplasties (RR = 4.02 (95%CI, 3.31–4.89)), obesity (RR = 3.85 (95%CI, 3.02–4.92)), surgical complications (RR = 3.40 (95%CI, 2.59–4.46)) and neoplasm (RR = 1.44 (95%CI, 1.40–1.48)) were more likely to be the underlying cause of death when PE was mentioned than when it was not. Cerebrovascular diseases (RR = 0.75 (95%CI, 0.68–0.82)), ischemic heart diseases (RR = 0.66 (95%CI, 0.61–0.72)) and heart failure (RR = 0.54 (95%CI, 0.50–0.59)) were less often reported on death certificates mentioning PE as associated cause of death. The results were not significantly different in men and women.

Discussion

In this study PE mortality has significantly decreased between 2000 and 2010 in people older than 55 years irrespective of sex. In 2010, PE was the underlying cause of death in only one third of the death certificates where PE was recorded. The crude mortality rate was 20.1 per 100 000 persons in 2010 when PE was considered as one of the multiple cause of death. After age adjustment the overall mortality rate was 21.0

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