Seasonal variation in the necropsy incidence of massive pulmonary embolism

J Green, C Edwards

Abstract

Aims—To investigate the seasonal incidence of massive pulmonary embolism at necropsy.

Methods—Massive pulmonary embolism was defined as a recent thromboembolus occluding the pulmonary trunk or one or both main pulmonary arteries and constituting the main cause of death. A total of 4289 necropsies carried out at East Birmingham Hospital from 1979 to 1988 was reviewed. The number of subjects with massive pulmonary embolism was noted and the accumulated percentage for each calendar month was calculated.

Results—Massive pulmonary embolism was found in 13.02 % of necropsies carried out in April; in September and October the percentage rose to 14.29 and 14.19, respectively, after falling to 8.04 and 7.80 in June and July. In January and February the incidence fell again to about 9 %.

Conclusions—The incidence of massive pulmonary embolism at East Birmingham Hospital is highest in the spring and autumn. Investigation of the seasonal incidence in arctic and tropical areas would be of interest.

(J Clin Pathol 1994;47:58-60)

Pulmonary embolism is a major cause of morbidity and mortality, accounting for up to 10 % of postoperative deaths and around 10% of deaths overall.¹⁻³ Age, heart disease, malignancy, trauma and recent surgery are well established predisposing factors,^{1,4,5} while the influence of gender remains controversial.^{1,3,4}

For some considerable time it has been apparent to us that the incidence of massive pulmonary embolism at necropsy is variable. Weeks or even months may go by without encountering a single case, and then quite suddenly virtually every patient will exhibit one or other sign of pulmonary embolic disease. Because it seemed possible that the increased morbidity associated with cold weather may also have been a pathogenic fac-

tor, the seasonal incidence of this condition was investigated.

Methods

The study was based on the necropsy records of East Birmingham Hospital for the 10 years from 1979 to 1988. East Birmingham is a district general hospital, situated on the east side of the Birmingham and Wolverhampton industrial conurbation. It houses general medical, general surgical, orthopaedic and geriatric units, and specialist units of thoracic surgery, thoracic medicine, cardiology, infectious disease and renal dialysis. Until 1992 there were no obstetric or gynaecological beds, and cardiac surgery and neurosurgery have always been carried out elsewhere in the city.

At East Birmingham, most patients coming to necropsy have died in the hospital. Subjects "brought in dead" to the accident unit are transferred to the public mortuary in accordance with the policy of the city Coroner. Recently, this policy has been extended to include a significant proportion of inpatient deaths, so that current necropsy data are not comparable with those of previous years. For this reason the December 1988 cutoff point was chosen.

For the purposes of this study, a massive pulmonary embolus was defined as recent adherent or non-adherent thromboembolus, situated either in the pulmonary trunk or in one or both main pulmonary arteries, and constituting the main cause of death. Subjects with thromboemboli in second order or smaller arteries were excluded, as were those with infarction alone. No attempt was made to assign patients to "medical", "surgical", or other categories.

For each calendar month, the total number of necropsies and the number with massive pulmonary emboli were noted. Monthly variation was investigated by arranging the data into 12 groups corresponding to the calendar months. Each group consisted of the total number of necropsies carried out in that specific month over the 10 year period, together with the number and percentage of subjects with massive pulmonary emboli (table).

Monthly incidence of pulmonary emboli at East Birmingham Hospital, 1979-88

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
No of necropsies	417	361	421	384	368	311	282	341	322	310	395	371
No of pulmonary emboli	38	33	48	50	30	25	22	41	46	44	44	43
% of pulmonary emboli	9.11	9.14	11.40	13.02	8.15	8.04	7.80	12.02	14.29	14.19	11.14	11.59

Department of
Histopathology, East
Birmingham Hospital,
Bordesley Green East,
Birmingham B9 5SS

J Green
C Edwards

Correspondence to:
Dr C Edwards

Accepted for publication
29 July 1993

The percentage of patients with massive pulmonary embolus in each month was compared with the percentage for the other 11 months using the formula for standard error of difference between percentages.⁶ Seasonal variation was investigated by comparing the figures for spring (March and April), summer (June and July), autumn (September and October) and winter (December and January), using the same method.

Results

In the 10 years studied, 4289 patients came to necropsy, with a more or less linear decrease in number per annum from 531 in 1979 to 335 in 1988, a trend which still continues. Massive pulmonary embolus was found in 461 (10.75%) cases. The annual percentage ranged from 9.0 to 12.61, but did not vary significantly (SD 1.27).

The numbers of necropsies for each month of the 10 year period, together with the numbers and percentages of cases with massive pulmonary embolism, are shown in the table. The correlation between the percentage of cases with massive emboli and the month is shown in the figure.

The percentage of patients with massive pulmonary embolus varied between 14.29 in September to 7.80 in July, with a mean (SD 2.58) of 10.74. There seemed to be two peaks, one in April and the other in September and October. The peaks were separated by a trough, which consisted of the months of May, June, and July, where the incidence fell to about 8 %. Statistical analysis, however, showed that only the October percentage (14.19) was significantly different from the rest of the year ($p < 0.05$). The percentage for April (13.02), September (14.29), May (8.15) and July (7.8) just failed to achieve significance ($p < 0.10$).

Further analysis of the data showed that the incidence of pulmonary embolus in the summer months of June and July was significantly lower than in the rest of the year ($p < 0.05$), lower than the spring months of March and April ($p < 0.03$), and lower than the autumn months of September and October ($p < 0.001$). The incidence in autumn was significantly higher than in the

winter months of December and January ($p < 0.05$), and significantly higher than in the rest of the year ($p < 0.01$).

Although significantly fewer necropsies were carried out in July ($p < 0.05$), there was no correlation between the number carried out and the percentage of cases with massive pulmonary embolism.

Discussion

At the start of this study, it was anticipated that there would be a peak in the winter months, in parallel with the seasonal increase in trauma and respiratory tract infection. The results, however, show that there are two peaks—one in the autumn and another in the spring.

The two peaks could be a reflection of the activity in the hospital over the year, with fewer complex cases being dealt with during the summer and Christmas holiday periods. Unfortunately, no data on the medical and surgical workload are available, but it is our impression that there is little if any change from month to month. East Birmingham is a district general hospital which deals, for the most part, with either emergency cases or patients with conditions such as malignancy or suspected malignancy requiring urgent investigation and treatment. "Cold" admissions from the surgical and medical waiting lists are fewer. Certainly, there was no correlation between the monthly total of necropsies and the incidence of pulmonary embolism.

There have been a few attempts to investigate the seasonal incidence of thromboembolic disease. Allen, in 1945, found that thrombotic disease was more common in the winter.⁷ By contrast, Scharnoff *et al*⁸ showed that in New York the spring and autumn were periods of high incidence and that winter and summer were periods of low incidence of thromboembolic disease. The shape of the graph they used to illustrate their paper is almost identical with ours. Both of these papers, however, were based on the overall incidence of thromboembolic disease, including pulmonary embolism or infarction, coronary artery thrombosis, myocardial infarction, mesenteric and cerebral thrombosis, and splenic and renal infarction. Scharnoff *et al* believed that the variation was due to thrombocytosis arising as a consequence of damage to megakaryocytes, occurring when periods of relative inactivity or immobility were followed by periods of resumed activity. Neither of these studies was corroborated by statistical analysis.

In a more recent paper, Putzke *et al*⁹ stated that pulmonary embolism in Rostock on the Baltic coast was more common during phases of fine weather in winter. These authors cited previous investigations published in the older German literature correlating pulmonary embolism with frontal systems, thunder, and the *föhn*, a warm wind which occurs in alpine areas. The authors were unable to confirm an association with weather fronts.

Monthly variation in the percentage of necropsies with massive pulmonary embolism.

Unfortunately, the paper contains no hard data, and the statistical analysis is described only in vague terms.

The reason for the increased incidence of massive pulmonary embolism in the spring and autumn is far from clear. There is, however, some indication from this and other studies that the weather may be a pathogenetic factor. Studies in arctic and tropical areas would be of interest,

We are grateful to Mrs Ruth Fry for her secretarial assistance in preparing this paper.

- 1 Coon WW. Risk factors in pulmonary embolism. *Surg Gynecol Obstet* 1976;143:385-90.

- 2 Rubinstein I, Murray D, Hoffstein V. Fatal pulmonary emboli in hospitalised patients. An autopsy study. *Arch Intern Med* 1988;148:1425-6.
- 3 Karwinski B, Svendsen E. Comparison of clinical and post mortem diagnosis of pulmonary embolism. *J Clin Pathol* 1989;42:135-9.
- 4 Hopkins NFG, Wolfe JHN. Thrombosis and pulmonary embolism. *BMJ* 1991;303:1260-2.
- 5 Raskob GE, Hull RD. Diagnosis and management of pulmonary thromboembolism. *Q J Med* 1990;76:787-97.
- 6 Swinscow TDV. *Statistics at square one*. 8th Edn. London: British Medical Association, 1983.
- 7 Allen AW, Linton RR, Donaldson GA. Venous thrombosis and pulmonary embolism. *JAMA* 1945;128:397-403.
- 8 Scharnoff JC, Rosenberg M, Mistica BA. Seasonal variation in fatal thromboembolism and its high incidence in the surgical patient. *Surg Gynecol Obstet* 1963;116:11-14.
- 9 Putzke HP, Möbius C, Gunther U, Bargenda M, Dobberphul J. Zur Häufigkeit der tödlichen Lungenembolie unter besonderer Berücksichtigung von Grundleiden und Wettereinfluß. *Z Gesamte Inn Med* 1989;44:106-9.