- Marshall, R., Sabiston, D. C., Allison, P. R., Bosman, A. R., and Dunnill, M. S. (1963). *Thorax*, 18, 1.
- Medd, W. E., and McBrien, D. J. (1962). *Lancet*, 1, 944.
- Morrell, M. T., Truelove, S. C., and Barr, A. (1963). *Brit. med. J.*, 2, 830.
- Murphy, D. M. G. (1963). *Ibid.*, 1, 1286.
- Orell, S. R. (1962). *Acta med. scand.*, 172, 473.
- Owen, W. R., Thomas, W. A., Castleman, B., and Bland, E. F. (1953). *New Engl. J. Med.*, 249, 919.
- Parker, B. M., and Smith, J. R. (1958). *Amer. J. Med.*, 24, 402.
- Petch, C. P. (1958). *Lancet*, 1, 741.
- Phear, D. (1960). *Ibid.*, 2, 832.
- Quenneville, G., Barton, B., McDevitt, E., and Wright, I. S. (1959). *Amer. J. Obstet. Gynec.*, 77, 1135.
- Robin, E. D., Forkner, C. E., Bromber, P. A., Croteau, J. R., and Travis, D. M. (1960). *New Engl. J. Med.*, 262, 283.
- Sabiston, D. C., and Wagner, H. N. (1965). *J. thorac. cardiovasc. Surg.*, 50, 339.
- Sasahara, A. S., and Stein, M. (editors) (1965). *Pulmonary Embolic Disease*. Grune and Stratton, New York.
- Sautter, R. D., Fletcher, F. W., Emanuel, D. A., Lawton, B. R., and Olsen, T. G. (1964). *J. Amer. med. Ass.*, 189, 948.
- Shaper, A. G., MacIntosh, D. M., Evans, C. M., and Kyobe, J. (1965). *Lancet*, 2, 706.
- Short, D. S. (1952). *Brit. med. J.*, 1, 790.
- Smith, G. T., Dammin, G. J., and Dexter, L. (1964). *J. Amer. med. Ass.*, 188, 143.
- Snodgrass, P. J., Amador, E., and Wacker, W. E. C. (1965). In *Pulmonary Embolic Disease*, p. 93, edited by A. A. Sasahara and M. Stein. Grune and Stratton, New York.
- Spittell, J. A. (1963). *Circulation*, 27, 976.
- Thompson, E. N., and Hamilton, M. (1962). *Lancet*, 1, 1369.
- Todd, M. E., Thompson, J. H., Bowie, E. J. W., and Owen, C. A. (1965). *Mayo Clin. Proc.*, 40, 370.
- Torrance, D. J. (1963). *The Chest Film in Massive Pulmonary Embolism*. Thomas, Springfield, Illinois.
- Wagner, H. N. (1965). In *Pulmonary Embolic Disease*, edited by A. A. Sasahara and M. Stein, p. 225. Grune and Stratton, New York.
- Sabiston, D. C., McAfee, J. G., Tow, D., and Stern, H. S. (1964). *New Engl. J. Med.*, 271, 377.
- Wilhelmsen, L., Selander, S., Söderholm, B., Paulin, S., Varnauskas, E., and Werkö, L. (1963). *Medicine (Baltimore)*, 42, 335.
- Wood, P. H. (1956). *Diseases of the Heart and Circulation*, 2nd ed. Eyre and Spottiswoode, London.

Pulmonary Emboli in Young Adults

C. A. LOEHRY,* M.B., M.R.C.P.

Brit. med. J., 1966, 1, 1327–1328

Thromboembolic disease in young patients has recently received much attention in both the popular and the medical press. There have been several reports of thrombotic episodes in young women taking oral contraceptives (Jordan, 1961; McIntyre *et al.*, 1962; Richman, 1962; McWilliam *et al.*, 1963; Reed and Coon, 1963; Minogue *et al.*, 1963; Stewart-Wallace, 1964; Schatz *et al.*, 1964; Baines, 1965; Hartveit, 1965; Leather, 1965; Nevin *et al.*, 1965), and it has been suggested that the drug may be responsible for intravascular thrombosis. It is, however, possible that the association is fortuitous, and that there has recently been an increased awareness of thromboembolic disease or an increase in the number of young adults suffering from the condition. It has been a clinical impression, while working in the medical wards, that an ever-increasing number of young patients with pulmonary emboli have been admitted in recent years. In order to study this further, the notes were obtained of all in-patients at St. Thomas's Hospital since 1956 diagnosed as cases of pulmonary emboli and under the age of 40. The present report is an analysis of this group of young patients in the 11-year period from 1954 to 1964, which is the latest date that accurately filed records are as yet available.

Results

After careful examination of the notes 94 patients were considered to have good evidence of emboli. Of these, 85 showed signs of pulmonary infarction, with pleuritic pain in every case, mostly with haemoptysis, and often with radiographic appearances of small transient areas of consolidation. Seven patients had massive emboli, with shock or syncopal attacks, and both clinical and electrocardiographic evidence of right auricular and ventricular strain. Of this group five subsequently died, and pulmonary emboli were demonstrated at necropsy. Two further cases were diagnosed only at necropsy. Altogether 58 patients had evidence of venous thrombosis in the legs, though in several of them this post-dated the embolic episode. The 94 patients were divided into two groups: in 62 cases additional features were present which

are known to predispose to thromboembolic disease, such as a recent operation, congestive cardiac failure, trauma, and pregnancy; in the remaining 32 cases there were no apparent precipitating features. The numbers of cases in both groups for each year since 1954 are given in the Table.

Incidence of Pulmonary Emboli in Young Adults

Year	Idiopathic Group	Other Factors Present	In-patient Population at St. Thomas's
1954	0	2	18,279
1955	0	6	18,375
1956	1	5	19,245
1957	1	5	19,739
1958	0	3	19,626
1959	1	3	19,765
1960	2	5	20,351
1961	3	4	20,926
1962	4	8	21,199
1963	8	11	21,207
1964	12	10	21,136

The most striking feature is the increased incidence of pulmonary emboli in these young patients since 1961. There has been some increase in both groups, but this is most pronounced in the idiopathic cases. In 1963 alone there were eight such patients, and in 1964 a further 12 who had previously been in good health and presented with emboli but no apparent precipitating cause, while there were no patients in this group in 1954 and 1955. Among the 62 cases complicated by other factors 34 had recently had an operation, 10 were in cardiac failure from rheumatic heart disease, six had recently been involved in an accident affecting their lower limbs, four were in the post-partum period, one had neoplastic disease, and seven were suffering from some other chronic medical condition.

The numbers of cases in both groups are compared with age (see Fig.). It is well recognized that older patients are more likely to develop thrombotic disease, and this is confirmed here in the "secondary" group, where there is a sharp rise in the number of cases after the age of 30. It is interesting that in the idiopathic group there was little difference in the number of patients in any age group. Though the number of cases in this group is not large, there is perhaps a suggestion from the evidence that different factors may be responsible here which are not influenced by age. There was little sex difference

* Medical Registrar, St. Thomas's Hospital, London. Now at the Royal South Hants Hospital, Southampton.

in the idiopathic group (17 men and 15 women), but the cases with other factors comprised 41 men and 21 women. Altogether 56 patients were treated with anticoagulants, 24 had no special treatment, and in 14 emboli persisted in spite of anticoagulant therapy, and ligation of the femoral or iliac veins or the inferior vena cava was performed.

Incidence of pulmonary emboli compared with age.

It is theoretically possible that the increased incidence of pulmonary emboli that has been demonstrated merely reflects a rise in the in-patient population or in the number of young adults admitted in recent years. The yearly figures for in-patients in the hospital group under survey (see Table) show only a small rise since 1960. Unfortunately a detailed study of age, sex, and social class of the patients is not available for all the years under consideration, but on the basis of the one-in-ten returns made by the hospital there has been no significant change in these variables from 1960 to 1964, which are the years that have shown the greatest rise in emboli.

Discussion

Several previous series have been published on the incidence of pulmonary emboli in all age groups. From post-mortem records Zeitlhofer and Reiffenstühl (1952) found that fewer cases of pulmonary emboli occurred during and just after each world war, though there was an increased incidence between the wars and a peak incidence in 1951. In another series Meister (1960) showed a rise in emboli between 1948 and 1950, with a decrease in the next three years. Other reports have in general shown an increased incidence of emboli over the last 60 years (Ochsner *et al.*, 1951; De Bakey, 1954). Morrell *et al.* (1963) collected cases from an Oxford hospital population during 1952 to 1961 and found a fivefold increase in the incidence of emboli. Most of these, however, were in the group where emboli were associated with other factors, and the increase was most pronounced in the older patients. This is confirmed in the present series of young adults, where the distribution of patients compares closely with other series. Approximately 55% of the secondary cases in the present survey were post-operative, compared with 30%, 37%, and 42.6% in other reports (Hermann *et al.*, 1961; De Bakey, 1954; Morrell *et al.*, 1963). The most striking feature, however, in the present series is the large increase in the incidence of thromboembolic disease in previously healthy young people. It seems unlikely that this is due to better diagnosis of the

condition, and there has been no significant rise in the number of in-patients during this time.

It is not possible to draw any definite conclusions on any aetiological factors at this stage; none of the women had been taking oral contraceptives, and, in fact, there was little difference in the numbers of either sex. The number of reports recently published concerning thrombotic episodes in young women taking these drugs may simply reflect the increased incidence of the disease in this age group as suggested by this survey. The Chicago Conference (1962) thought it unlikely that there was any true relationship between thrombosis and contraceptives, and the interim report of the Dunlop Committee has come to much the same conclusion. It is possible that with the increasing incidence of coronary and peripheral vascular disease the rise in numbers of cases of thromboembolic disease is part of a generalized increase of vascular disorders. Several of the patients in this series showed no evidence of venous thrombosis in the legs. Absence of this factor in the presence of pulmonary emboli is well recognized (Thompson and Hamilton, 1962), as is its appearance after the embolic episode (Stevens, 1961).

Summary

The notes of all in-patients at St. Thomas's Hospital presenting with pulmonary emboli between 1954 and 1964, and who were under the age of 40, have been examined.

Out of 94 cases 62 were associated with other factors known to predispose to thromboembolic disease. The remaining 32 had no apparent precipitating factors.

A large increase in the incidence of pulmonary emboli since 1961 is shown, especially in the previously healthy young adults. None of the female patients in the group had been taking oral contraceptives, and it is suggested that the recent number of cases associating thromboembolic disease and these drugs reflects an increased incidence of pulmonary emboli in young people.

REFERENCES

- Baines, G. F. (1965). *Brit. med. J.*, **1**, 189.
- Chicago Conference (1962). Conference on thrombo-embolic phenomena in women. Searle.
- De Bakey, M. E. (1954). *Int. Abst. Surg.*, **98**, 1.
- Hartveit, F. (1965). *Brit. med. J.*, **1**, 60.
- Hermann, R. E., Davis, J. H., and Holden, W. D. (1961). *Amer. J. Surg.*, **102**, 19.
- Jordan, W. M. (1961). *Lancet*, **2**, 1146.
- Leather, H. M. (1965). *Ibid.*, **1**, 270.
- McIntyre, N., Phillips, M. J., and Voigt, J. C. (1962). *Brit. med. J.*, **2**, 1029.
- McWilliam, R. S., Macdonald, A. J., and Lindsay, I. (1963). *Canad. med. Ass. J.*, **88**, 1032.
- Meister, H. (1960). *Frankfurt. Z. Path.*, **70**, 640.
- Minogue, W. F., Halperin, I. C., Soler-Bechara, J., Varriale, P., and Flood, F. B. (1963). *New Engl. J. Med.*, **268**, 1037.
- Morrell, M. T., Truelove, S. C., and Barr, A. (1963). *Brit. med. J.*, **2**, 830.
- Nevin, N. C., Elmes, P. C., and Weaver, J. A. (1965). *Ibid.*, **1**, 1586.
- Ochsner, A., De Bakey, M. E., De Camp, P. T., and da Rocha, E. (1951). *Ann. Surg.*, **134**, 405.
- Reed, D. L., and Coon, W. W. (1963). *New Engl. J. Med.*, **269**, 622.
- Richman, G. (1962). *Brit. med. J.*, **2**, 729.
- Schatz, I. J., Smith, R. F., Breneman, G. M., and Bower, G. C. (1964). *J. Amer. med. Ass.*, **188**, 493.
- Stevens, A. E. (1961). *Lancet*, **2**, 1005.
- Stewart-Wallace, A. M. (1964). *Brit. med. J.*, **2**, 1528.
- Thompson, E. N., and Hamilton, M. (1962). *Lancet*, **1**, 1369.
- Zeitlhofer, J., and Reiffenstühl, G. (1952). *Wein. klin. Wschr.*, **64**, 446.