

PROGNOSTIC MODELS FOR THE POSTMORTEM INCIDENCE OF PULMONARY THROMBOEMBOLISM

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Key-words: pulmonary thromboembolism — prognostic model — incidence — postoperative death

There exist an obvious data for the rising incidence of pulmonary thromboembolism (PTE) in recent decades (2, 4, 5, 17, 18, 26). However, the estimation of the real PTE incidence is getting more complicated because of the fact that a small number of PTE cases (20—40 per cent) can be diagnosed before one dies (1, 22). Autopsy material gives more reliable results. However, one must have in mind that most PTE patients survive (16). That is why autopsy data cannot be representative for the population as a whole. Besides, for some reasons which we will discuss further on, pathologo-anatomical examinations demonstrate a rather different PTE incidence (12, 14, 15, 19, 20, 22, 27).

The aim of the present study is to ascertain the dynamics of PTE incidence for a long period of time and to elaborate prognostic models for this incidence in the next five years.

Material and methods

PTE incidence for a 20 year period (1963—1982) was retrospectively studied on the basis of a total of 13 871 autopsies done at the Department of Pathological Anatomy, Higher Institute of Medicine, Varna. Autopsy material originated from all hospitals in the Varna district. The mean hospital autopsy rate was about 98 per cent. The investigation included all kinds of thrombotic occlusions of pulmonary arteries — embolic and autochthonous — no matter what their size was. The staff of the department directs his attention to diagnose and investigate the thromboembolic complications by using of routine methods.

Prognostic models were elaborated by means of polynome approximation by the method of minimized squares of residuals in order to find out the tendencies in the development of PTE incidence in the next 5 years:

$$F = \min \left[\sum_{i=1}^n (z / x_i - y_i)^2 \right] \quad (1), \text{ where}$$

« x_i » was an independent variable (years), « y_i » — empirical PTE incidence in per cent, and « z » — a predictor variable (an equalized incidence).

Four different models were tested:

$$\text{I}^{\text{st}} - Z = ax + \frac{b}{x} + c$$

$$\text{II}^{\text{nd}} - Z = \frac{a}{x} + b$$

$$\text{III}^{\text{rd}} - Z = a \cdot 10^{mx}$$

$$\text{IV}^{\text{th}} - Z = a + bx,$$

(2), where

«a», «b», «c» and «m» were partial regression coefficients of annual frequency changes according to the formula (1).

The confidence interval of theoretically calculated frequency was ascertained by determination of maximal representative error (Δ):

$$\Delta = t \sqrt{\frac{\sum_{i=1}^n (z_i / x_i - y_i)^2}{n-2}} \quad (3), \text{ where}$$

«n» was the number of years, «t» was probability level of 0.95 at $K=n-2$ degrees of freedom.

Because of possible condition changes or of new factors' arising the probability for the real incidence to fall into the confidential interval in the next years decreased. This corrected probability for a 5-year period was calculated after the formula $P_t = P_0 \cdot K$ (13), where $P_0=0.95$ was the probability level of the prognosticated quantity to fall into the confidence interval at the beginning of this period; K — coefficient of the increase of uncertainty for a unit of time, in our case $K=0.95$, t — number of years for prognostication. In our study $P_5=0.74$, i. e. the probability for PTE incidence to fall into the confidential interval prognosticated decreased in 5 years to 0.74.

Results and discussion

PTE was found in 1772 cases (12.77 ± 0.53 per cent) out of all 13 871 autopsies (stillborns and abortions excepted) during the 20-year period. This incidence was considerably lower than the real one, as children aged up to 14 years with PTE incidence of only 1.20 per cent were 29.92 per cent of the necropsies proper. PTE incidence was considerably higher (17.61 ± 0.75 per cent) when deceased persons over 14 years of age were concerned. There were significant differences between PTE incidence among deceased therapeutic patients (12.09 ± 0.59 per cent) and that one among patients died after surgical interventions (16.45 ± 1.55 per cent) ($p < 0.001$).

The follow-up of PTE frequency dynamics in patients aged over 14 years during the 20-year period demonstrated a clearly expressed tendency towards increase for the first half of the period. However, regardless of great variations—the rate of increase sharply delayed in the last 10 years. That was why we considered the second model ($Z = \frac{a}{x} + b$) where PTE incidence remained high and almost without any increase, i. e. where the phenomenon of saturation was present, the most appropriate one in our case (fig. 1). Thus, it could be suggested that in the next 5 years PTE incidence among deceased persons aged over 14 years would vary between 15 and 22 per cent (supported by probability of 0.95 and 0.74 for 1987, respectively).

The analysis of incidence dynamics in males (fig. 2) and in females (fig. 3) aged over 14 years showed similar trends. It retained its highest levels between 19.9 and 28 per cent in females according to the prognosis.

Postoperative PTE incidence has increased rapidly in the initial 12 years (until 1975). However, it showed a tendency towards saturation at a rather high

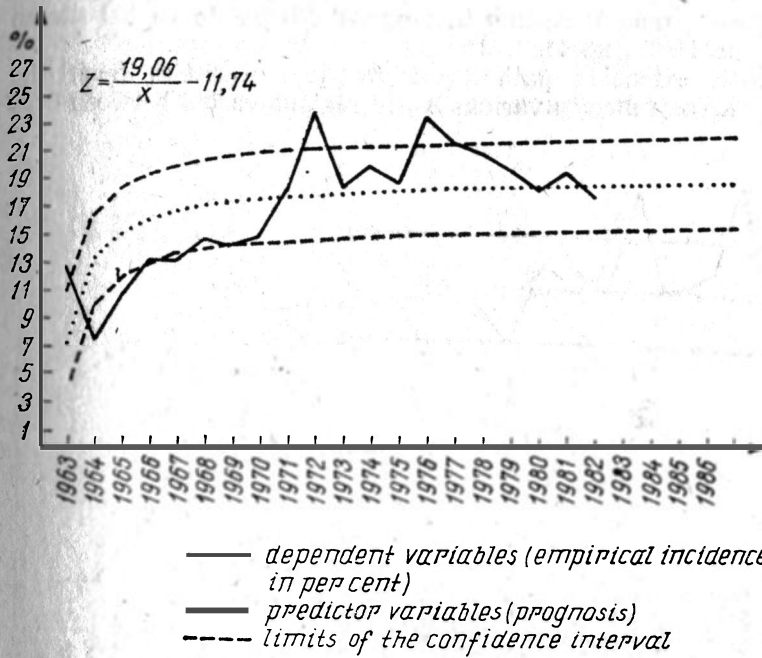


Fig. 1. Prognostic model for PTE incidence in patients (males and females) over 14 years of age

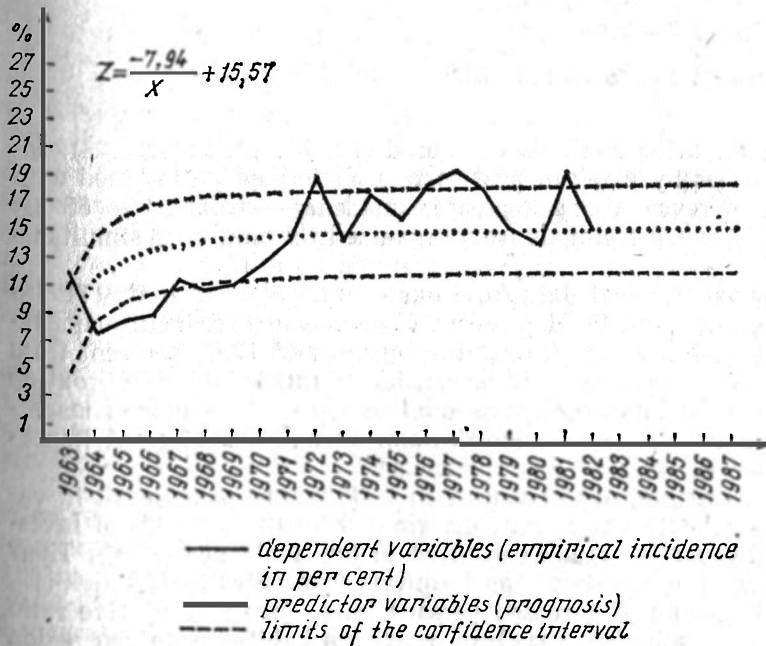


Fig. 2. Prognostic model for PTE incidence in males over 14 years of age

level in the recent 7 years, too. According to prognosis, it would vary between 14.5 and 25.5 per cent in 1987 (fig. 4).

In accordance with extensive pathologo-anatomical statistics from the recent two decades, PTE incidence in various world regions varied between 0.76

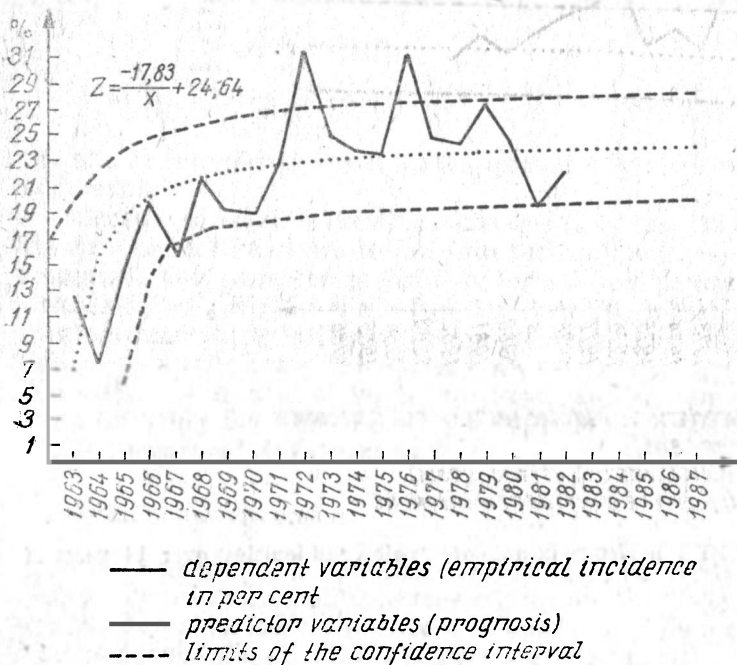


Fig. 3. Prognostic model for PTE incidence in females over 14 years of age

and 18.5 per cent when routine methods were used (12, 18, 19, 21—23, 28). Investigations of small series by using of postmortem angiography combined with histological examination revealed much greater incidence — from 23 to 65 per cent (14, 15, 17, 20, 27), when residuals from organized thrombi were simultaneously given render of.

Recently, pathologoanatomical data from our country showed that PTE incidence varied between 3.48 and 17.51 per cent (6,9). Mean PTE incidence established in our study (12.77 per cent from all autopsies and 17.61 per cent from those of patients aged over 14 years) could be considered rather high when routine methods were used. This indicated that purposeful search in the course of macroscopic and histologic examination of microthrombi as well was of great importance for determination of the real PTE incidence.

In our opinion, the striking discrepancies in PTE incidence reported in various pathologoanatomical trials were first determined by the methods of investigation. As a rule retrospective studies resulted in low incidence (7—9). Their rates were influenced by the profile of the hospitals (concentration of high-risk patients), the age distribution of deceased persons (e. g. different relative ratio of pediatric contingent), nosological structure, nutrition habits in a given region

(e. g. in Japan it was 0.76 per cent — 21), terminological differences, rendering an account of fatal embolism only, mean autopsy rate, etc.

The rising and stabilization of the high PTE incidence is undoubtedly determined by a series of factors such as changes of nutrition habits resulting in

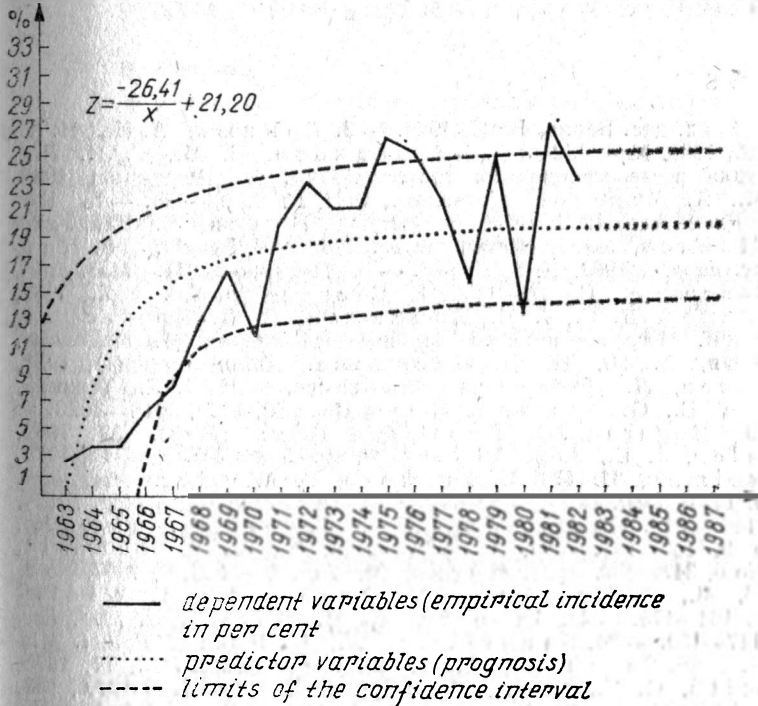


Fig. 4. Prognostic model for postoperative PTE incidence

an increase of the relative share of animal fats in the diet (3, 18, 24), in a rising incidence of cardiovascular diseases and malignant neoplasms both (10, 11) prolongation of average life span and of life of severely ill patients (18), rising number of mayor and difficult surgical interventions, modern drug therapy (especially neuroleptic use on a large scale) (1, 6), etc. The determination of the relative value of the aforementioned factors for PTE arising is very difficult, indeed.

It has long been known that surgical treatment increases considerably the risk for the development of thromboembolic complications, especially of PTE (3, 4, 11, 19). Our investigation confirms this statement. PTE are significantly more frequent (16.45 per cent) in postoperative patients than in cases on conservative treatment (12.09 per cent).

The analysis of the dynamic variation of PTE incidence during the 20-year period reveals its sharp increase in the initial 10—12 years when 4 main groups are concerned (total number of deceased aged over 14 years; males aged over 14 years, females aged over 14 years, and postoperative fatal cases). Recently, a tendency towards a diminution of growth rate of PTE incidence to the extent of saturation can be noted. Our prognostic models result in almost horizontal curve indicating an equalized incidence in the next 5 years, i. e. this incidence

may be expected to remain practically unchanged. Taking into consideration that there is a lethal outcome only in 30 per cent of PTE cases (16.25) we can calculate the approximate number of patients expected to develop PTE on the basis of the prognostic models proposed. These data can be applied for planning the needs of the practical public health services.

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ПРОГНОСТИЧЕСКИЕ МОДЕЛИ ПОСМОРТАЛЬНОЙ ЧАСТОТЫ ЛЕГОЧНЫХ ТРОМБОЭМБОЛИЙ

А. Ангелов

РЕЗЮМЕ

На обширном аутопсионном материале (13 871 аутопсия за период с 1963 по 1982 г. г.) исследована частота легочных тромбоэмболий. Наличие легочных тромбоэмболий устанавливается в 1772 случаях, что составляет 12,77 % всех случаев. Частота легочных тромбоэмболий возрастает более чем в два раза за исследуемый период. В 16,45 % всех умерших после операций устанавливается наличие легочных тромбоэмболий, в то время как у больных, лечившихся консервативно, установлена еще более низкая частота — 12,09%. Это приводит к выводу об определенной связи между наличием легочных тромбоэмболий и оперативным лечением. Прогностические модели показывают, что в следующих 5 лет частота легочных тромбоэмболий останется высокой, но без тенденции к еще большему возрастанию.