

Monoaminergic Innervation of the Pulmonary Vessels in Various Laboratory Animals (Rat, Rabbit, Cat)

Using electron microscopy, a number of authors have recently proved that the vegetative nerve terminals are situated in the arterial wall only in a small zone between the media and adventitia (BRETTSCHEIDER¹, BURNSTOCK et al.²). The nerve fibres in the arteries of peripheral circulation never penetrate through the external elastic membrane and are never found between the muscle cells in the media. The histochemical fluorescence method according to FALCK³ has confirmed these findings (FUXE⁴, DOLEŽEL⁵) and has besides proved the monoaminergic transmission in these terminals. Only in some arteries that may be assumed to perform some special function, e.g. some arteries in the iris (EHINGER⁶), in the fingertips and in the corpora cavernosa (FALCK⁷), have monoaminergic terminals been found between the muscle cells of the media.

We were interested to find out whether the system of innervation described would be found also in the pulmonary circulation. Using electron microscopy, ALTENÄHR⁸ has not found any nerve terminals in the pulmonary arteries of the rat. On the other hand, the same author has found a dense nervous net of terminals on the surface of the media in bronchial arteries. We have investigated the lungs of rats, rabbits and cats. According

to GREBENSKAJA⁹ and JUNG¹⁰, the rabbit has muscular-type pulmonary arteries. Moreover, in the rabbit, the muscular layer of these arteries is considerably thicker than in the arteries of peripheral circulation. We have used the histochemical fluorescence method according to FALCK³ in lyophilized tissue embedded in paraffin, and have examined the lungs of 10 rats, 5 rabbits and 3 cats.

The pulmonary artery of the rat is an elastic one with a small number of smooth muscle cells in the wall. We have not found any monoaminergic nerve terminals on the surface of the media (Figure 1). Only a small amount of terminal could be found in the adventitial layer. As the

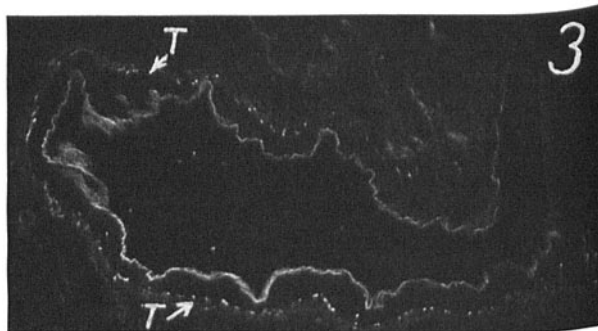


Fig. 3. Pulmonary artery of the rabbit (the distal part with thin wall) (FALCK). T = nerve terminals on the surface of the media.

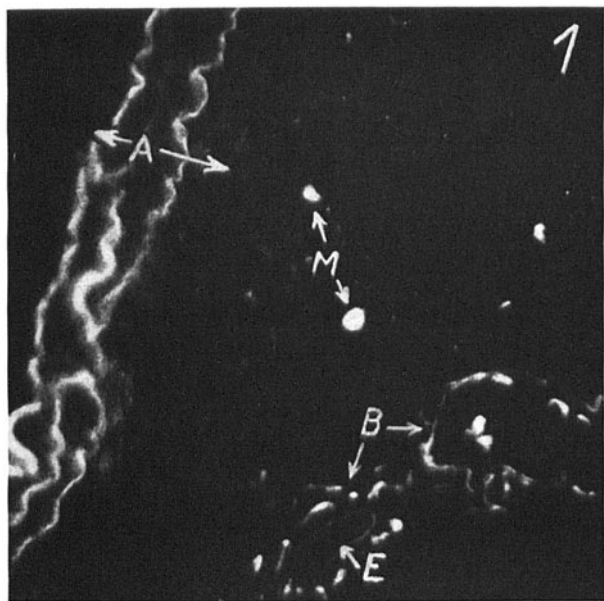


Fig. 1. Pulmonary artery of the rat (FALCK). A = wall of the pulmonary artery; B = bronchial artery; M = mast cells.

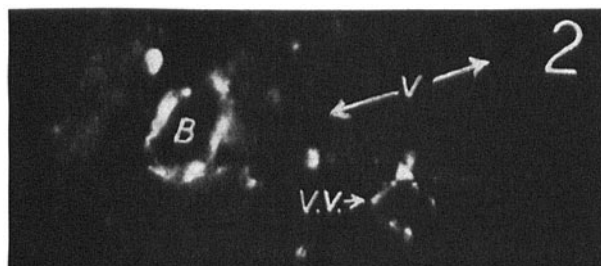


Fig. 2. Bronchial artery of the rat (FALCK). B = bronchial artery with nerve terminals; V.V. = small artery in the wall of the pulmonary vein; V = wall of the pulmonary vein.

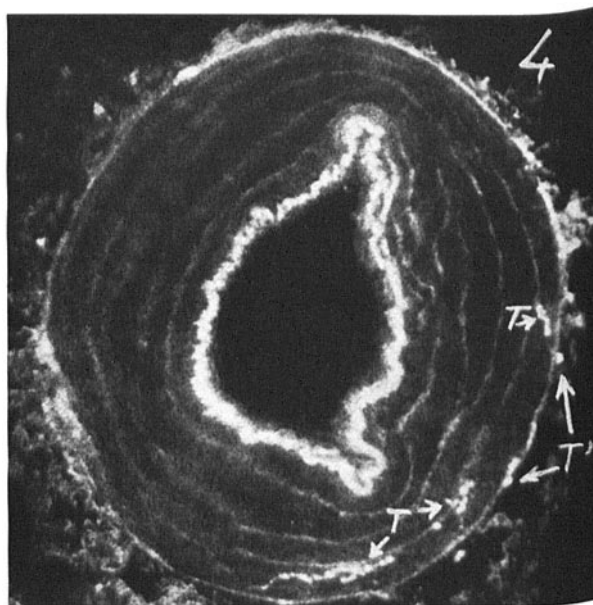


Fig. 4. Pulmonary artery of the rabbit (the proximal part with thick wall) (FALCK). T = nerve terminals inside the media; T' = nerve terminals on the surface of the media.

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- ⁶ B. EHINGER, Acta Univ. lund. II, No. 20 (1964).
- ⁷ B. FALCK, personal communication (1965).
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- ⁹ N. I. GREBENSKAJA, Arkh. Anat. Gistol. Embriol. 47, 84 (1964).
- ¹⁰ S. JUNG, Zucht und Haltung der wichtigsten Laboratoriumversuchstiere (Gustav Fischer Verlag, Jena 1958).

amount of such fibres is very small, they cannot have any significance for the function of the vessels. The bronchial arteries of the rat and the vasa vasorum have a normal dense network of nerve terminals on the surface of the media (Figures 1 and 2). Consequently, with regard to the innervation of the pulmonary blood bed in the rat, the results achieved by the described methods are in complete agreement.

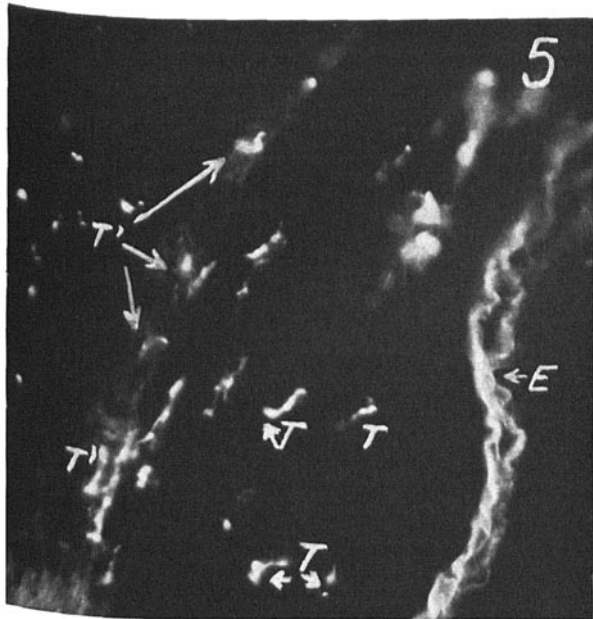


Fig. 5. Pulmonary artery of the rabbit (the distal part with thin wall) (FALCK). E = lamina elastica interna; T = nerve terminals inside the media; T' = nerve terminals on the surface of the media.

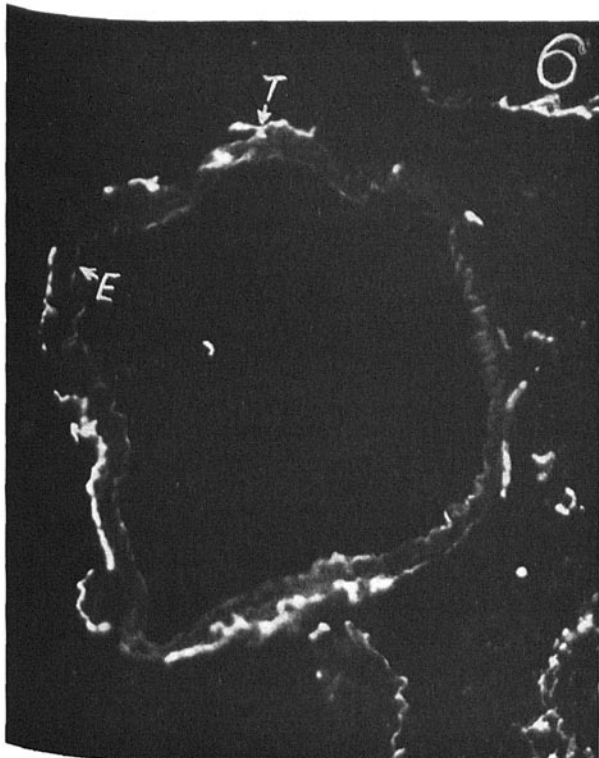


Fig. 6. Pulmonary artery of the cat (FALCK). T = nerve terminals on the surface of the media; E = lamina elastica interna.

In the cat we have found the monoaminergic nerve terminals on the surface of the media both in pulmonary arteries and in bronchial ones (Figures 6 and 7).

In the rabbit the proximal parts of the pulmonary arteries have thick media with numerous layers of smooth muscle cells and numerous concentrically arranged fine elastic membranes. The large amount of smooth muscular tissue decreases distally, and small branches of the pulmonary blood bed have the structure of elastic vessels. Surprisingly, on the surface of the media we have found a dense network of monoaminergic nerve terminals (Figure 3). In some places the fibres of this network penetrate through the external elastic layer and form a small area with a dense network of terminals between the muscle cells of the media (Figure 4). In the proximal thick-walled part of the pulmonary artery, areas of direct innervation of the media can be found only in some sections of the outer layer. In the distal thin-walled part, on the other hand, areas of direct innervation can be found in sections penetrating the entire wall as far as the intima (Figure 5). It is extremely difficult to identify the bronchial arteries in the rabbit by means of the fluorescence microscope; therefore we are not in a position to give a description of their innervation.

The established differences in the morphology of the innervation of the pulmonary blood bed as displayed by the three species of laboratory animals mentioned, seems to be of particular interest, especially in regard to evaluation of experiments.

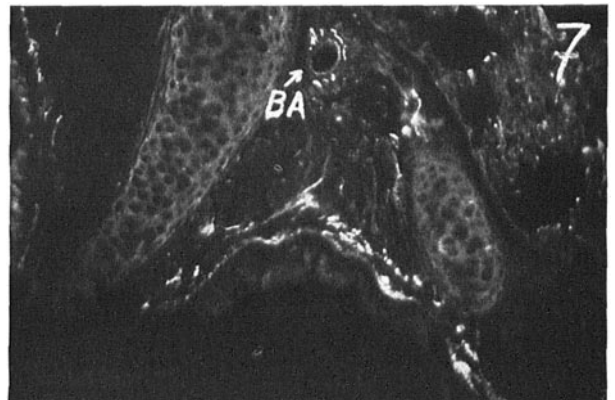


Fig. 7. Bronchus and bronchial artery of the cat (FALCK). BA = bronchial artery with nerve terminals on the surface of the media.

Zusammenfassung. Mit Hilfe der histochemischen Fluoreszenzmethode nach FALCK³ wurde die monoaminergische Innervation der Lungengefäße bei der Ratte, beim Kaninchen und bei der Katze untersucht. Während die Pulmonalarterie der Ratte keine Nervenendigungen aufweist, wurden solche an der Oberfläche der Media festgestellt. Bronchial- und Pulmonalarterien der Katze besitzen die monoaminergische Innervation nur an der Oberfläche der Media. Im Unterschied zur Ratte besitzt das Kaninchen eine typisch muskuläre Pulmonalarterie und reiche monoaminergische Innervation an der Oberfläche der Media.

S. ČECH and S. DOLEŽEL

Department of Histology and Embryology, J. E. Purkyně University, Brno and Czechoslovak Academy of Sciences, Institute of Normal and Pathological Physiology, Department of Cardiovascular Physiology, Bratislava (Czechoslovakia), July 21, 1966.