

Adrenergic and cholinergic innervation of the chicken pancreas

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The distribution, as well as the morphological characteristics of adrenergic and cholinergic nerve fibres was studied in the pancreas of the hen and the cock. The presence of numerous adrenergic and moderately numerous cholinergic structures was revealed in the organ. They were seen as nerve fibre bundles or single nerve fibres located in the vicinity of blood vessels and exocrine ducts, as well as the cells of the exocrine and endocrine pancreas. Single TH- and ChAT-positive nerve cell bodies were also found in the organ under study.

key words: chicken, pancreas, innervation

INTRODUCTION

It is well established that the production and secretion of four pancreatic hormones, namely insulin, glucagon, somatostatin and pancreatic polypeptide is controlled by the autonomic nervous system [7]. It has also been discovered that the postganglionic adrenergic nerve terminals in the pancreas release noradrenaline (NA) which, via alpha- and/or beta-adrenoceptors, enhances or inhibits pancreatic secretory functions [5]. Papers dealing with the adrenergic innervation of the pancreas are, surprisingly, scarce. 30 years ago the existence of these fibres was mentioned in the pancreas of amphibians, reptiles, birds [4, 9] and mammals [5].

More attention was paid to the cholinergic innervation of the pancreas of vertebrates, including birds [1–3, 6, 8, 10]. However, the available literature leads to the conclusion that data on the innervation of the internal organs, including the pancreas, of birds are very limited. It was decided to describe the distribution of the adrenergic and cholinergic nerve structure in the pancreas of the domestic hen, a bird of great importance from the economic point of view.

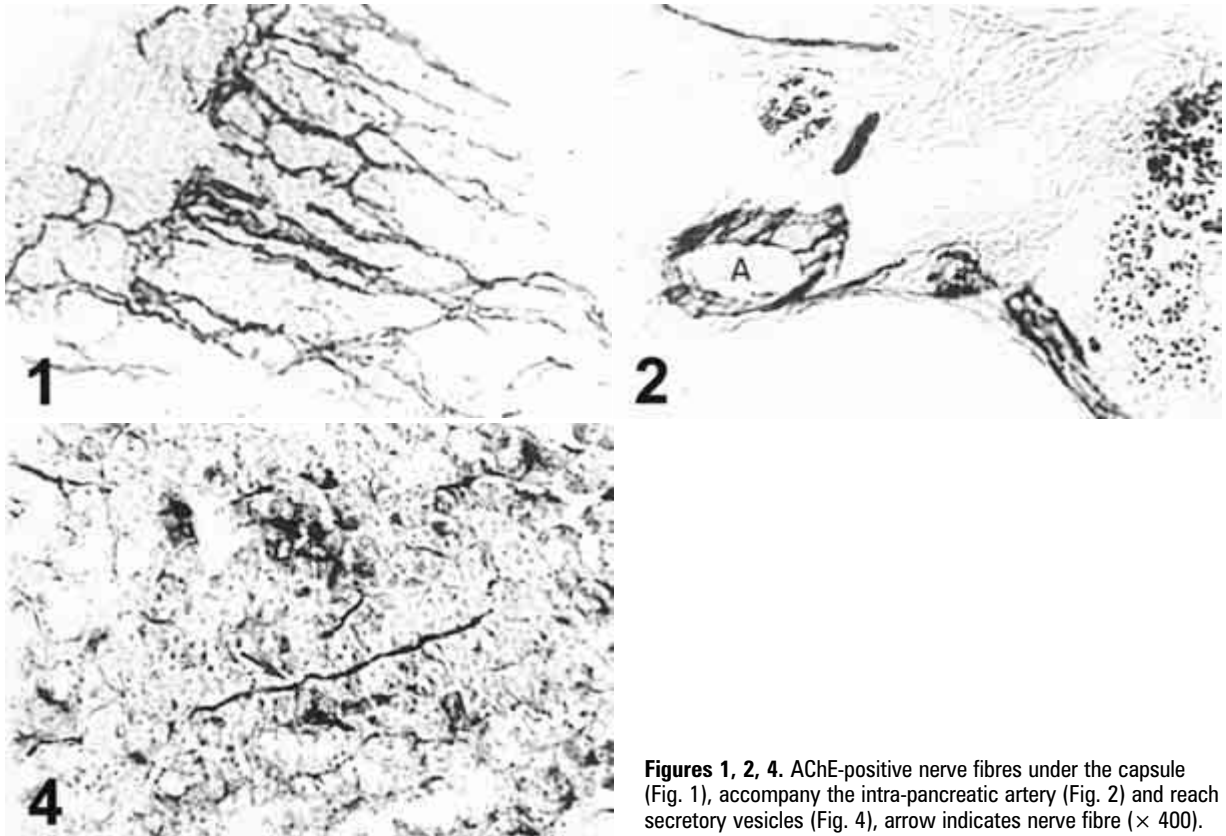
MATERIAL AND METHODS

3 adult hens and 3 adult cocks of the green-leg variety were used for the study. The detection of adrenergic nerve fibres was performed using the Torre and Surgeon method, as well as with immunohistochemistry with antibody against tyrosine hydroxylase (TH). The detection of cholinergic nerve fibres was performed using the Karnovsky and Roots method, as well as with immunohistochemistry with antibody against choline acetyltransferase (ChAT). The specificity of immunohistochemical staining was verified with omission and replacement tests.

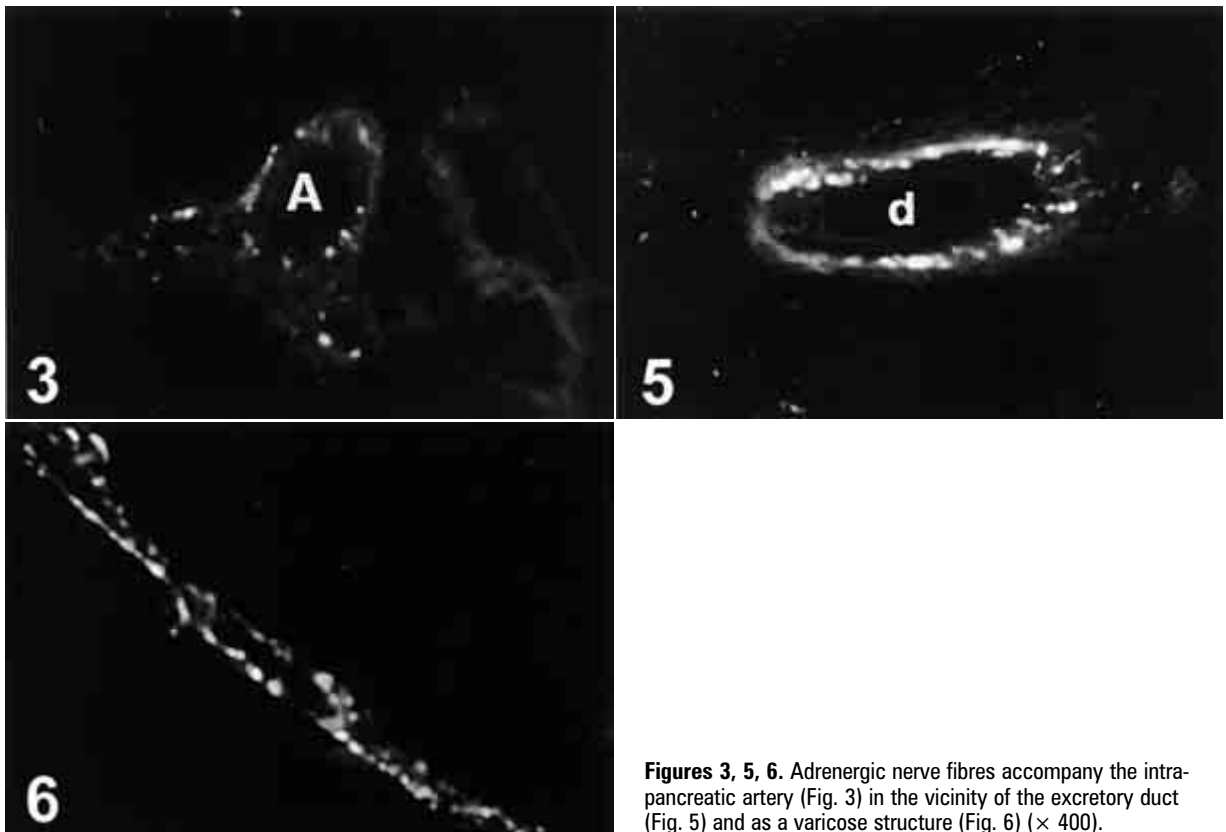
RESULTS AND DISCUSSION

Both cholinergic and adrenergic nerve fibres enter the hen pancreas with blood vessels and their ramifications accompany the smaller vascular branches. In the pancreas, the nerve fibres can be seen as thick bundles, small bundles or single nerve fibres. Numerous AChE-positive nerve fibres were seen under the capsule of the organ (Fig. 1). Both populations of nerve fibres accompany the intra-pancreatic arteries (Fig. 2, 3) running in the connective tissue extending to the vicinity of the secretory vesicles and

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Figures 1, 2, 4. AChE-positive nerve fibres under the capsule (Fig. 1), accompany the intra-pancreatic artery (Fig. 2) and reach secretory vesicles (Fig. 4), arrow indicates nerve fibre ($\times 400$).



Figures 3, 5, 6. Adrenergic nerve fibres accompany the intra-pancreatic artery (Fig. 3) in the vicinity of the excretory duct (Fig. 5) and as a varicose structure (Fig. 6) ($\times 400$).

Langerhans islets (Fig. 4). Some of the adrenergic and cholinergic nerve fibres run in the direct vicinity of the excretory ducts (Fig. 2, 5). Single adrenergic terminals located in the neighbourhood of effector cells have a varicose appearance (Fig. 6). Single TH- and ChAT-positive neurons were found in the gland (Fig. 7, 8).

The results presented in this paper indicate that the hen pancreas is supplied with cholinergic and adrenergic nerve fibres. The nerve structures contain substances such as noradrenaline (NA) and TH, characteristic for adrenergic nerve fibres, as well as acetylcholine esterase (AChE) and ChAT, characteristic for cholinergic nerve fibres. The present results agree with the results of previous studies performed on other birds, where the presence of AChE-positive nerve fibres was described in the pancreas [4, 6, 10]. The present results also confirm the results of studies performed in the chicken where cholinergic nerve fibres were found in the pancreatic gland [1–3].



Figure 7. TH-positive neuron, arrow indicates perikarion ($\times 400$).

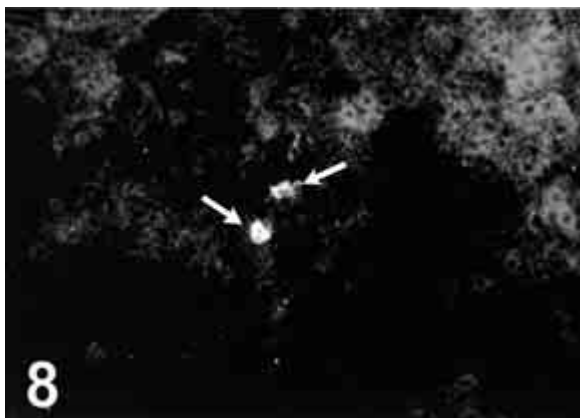


Figure 8. ChAT-positive neurons, arrows indicate perikarions ($\times 400$).

Additionally, the presence of the vesicular acetylcholine transporter (VACHT) was detected in the pancreas of the hen. VACHT was detected in the neurons located in the exocrine and endocrine part of the rat pancreatic gland [8]. There is a significant absence of reports dealing with the adrenergic innervation of the avian pancreas. The present results describe abundant adrenergic innervation of the hen pancreas, whereas previous references have only been to the pancreatic adrenergic innervation of a number of bird species [9].

The present results confirm the existence of single TH and ChAT-positive perikarya, which have been described previously [2]. The function of these neurons is still obscure.

It may be assumed that the control function of the autonomic nervous system in the exocrine and endocrine pancreas is exerted via stimulation and inhibition of the secretory functions, as well as the regulation of constriction and relaxation of the blood vessels and excretory ducts.

Further studies on the functional significance of adrenergic and cholinergic innervation of the pancreas should take into consideration other biologically active substances (for example neuropeptides) localised in the pancreatic neurons. Thus, the present results can only be regarded as preliminary.

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