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The adrenergic and cholinergic innervation of the chicken *vas deferens*

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The morphological characteristics of adrenergic and cholinergic innervation are described in the vas deferens *of the domestic fowl. Adrenergic innervation was much better developed than the cholinergic. Both types of nerve fibre were found in the muscular membrane, submucosal membrane and in the mucosa. The largest number of adrenergic nerve fibres was observed in the muscular membrane. These were less numerous in the submucosa, mucosa and in the wall of small blood vessels. The largest number of cholinergic nerve fibres was noted under the mucosa. Single cholinergic nerve fibres were seen to penetrate between the epithelial cells.*

Key words: chicken, *vas deferens*, innervation

INTRODUCTION

Innervation of the mammalian male genital tract has been fairly well surveyed. The adrenergic, cholinergic and peptidergic innervation of the *vas deferens* have been extensively studied in many mammalian species, including humans [1, 5], swine, the guinea pig, and the rat [6].

Publications dealing with the innervation of the avian reproductive tract are very sparse. There are no publications dealing exclusively with innervation of the *vas deferens* in birds. The available literature describes innervation of the entire cock genital tract [9] and the general structure of the adrenergic nervous system of the chicken [3].

The present study was aimed at describing the distribution of adrenergic and cholinergic nerve fibres in the *vas deferens* of the domestic fowl, a bird of great economic value.

MATERIAL AND METHODS

A population of 3 adult cocks of the Hamburg race, the white-speckled variety, were used for the study. Adrenergic innervation was demonstrated according to the method of de la Torre and Surgeon [4]. The detection of cholinergic nerve fibres was performed using the Karnovsky and Roots method [7].

RESULTS AND DISCUSSION

The adrenergic innervation of the cock *vas deferens* is well developed. The largest number of the adrenergic nerve bundles was associated with the muscular membrane (Fig. 2). The nerve fibres ran in both circular and longitudinal layers. Many of the adrenergic nerve fibres were associated with the small blood vessels (Fig. 1). Numerous adrenergic nerve fibres were found in the submucosa (Fig. 2).

The adrenergic innervation in the mucosa was weaker than in the muscular membrane. The nerve fibres generally ran in a circular manner (Fig. 3). Some of adrenergic nerve fibres were found under the epithelium (Fig. 4). The distribution of adrenergic nerve fibres was similar throughout the *vas deferens*.

The AChE-positive innervation was much weaker than the adrenergic. The cholinergic nerve fibres were observed in the circular as well as in the longitudinal

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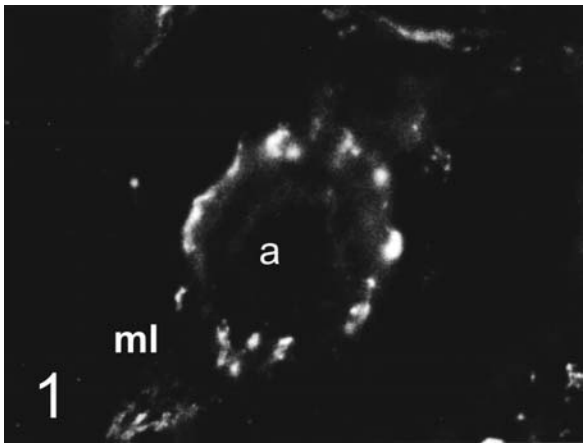

Figure 1. Initial part of the *vas deferens*. Adrenergic nerve fibres associated with small blood vessel (× 400). Adrenergic nerve fibres in the chicken *vas deferens;* a — artery, ml — muscular membrane.

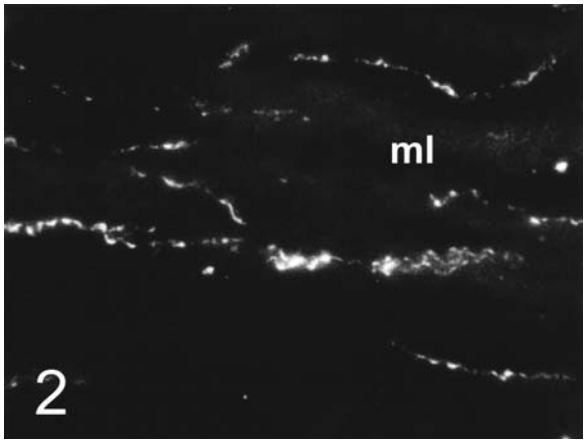

Figure 2. Initial part of the *vas deferens*. Adrenergic nerve fibres in the muscular membrane (× 400). Adrenergic nerve fibres in the chicken *vas deferens;* ml — muscular membrane.

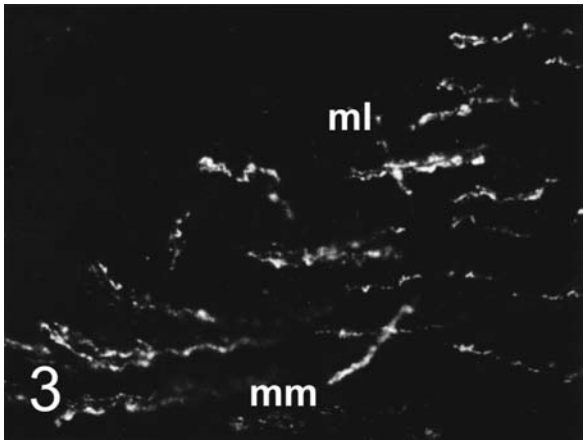

Figure 3. Central part of the *vas deferens*. Adrenergic nerve fibres in the muscular membrane and in the mucosa (× 400). Adrenergic nerve fibres in the chicken *vas deferens;* mm — mucosa, ml — muscular membrane.

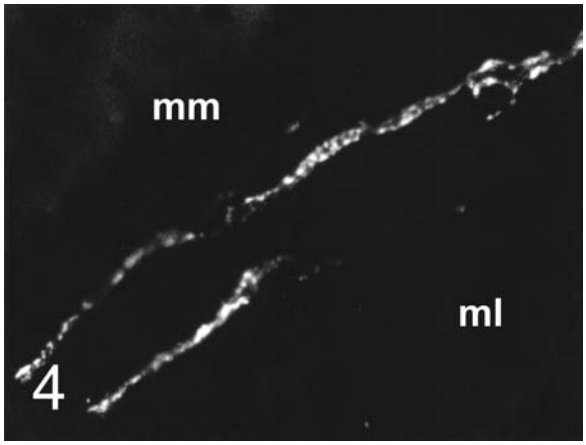

Figure 4. Cloacal part of the *vas deferens*. Adrenergic nerve fibres in the mucosa (× 400). Adrenergic nerve fibres in the chicken *vas deferens;* mm — mucosa, ml — muscular membrane.

muscular membrane (Fig. 5). There were no cholinergic nerve fibres associated with blood vessels.

The cholinergic nerve fibres in the mucosa generally ran circularly (Fig. 5). The cholinergic nerve plexus in the chicken *vas deferens* was observed mainly under the mucosa (Fig. 5). Many of the cholinergic nerve fibres ran under the epithelium (Fig. 6). Single nerve fibres were seen to penetrate between the epithelial cells (Fig. 6), mainly in the central section of the *vas deferens*.

The general distribution of the cholinergic nerve fibres was similar in the entire *vas deferens*. The present study has shown that the *vas deferens* of the cock is supplied with both adrenergic and cholinergic nerve fibres. It is generally accepted that adrenergic fibres are excitatory to the smooth musculature of the *vas deferens*. Adrenergic innervation stimulates contraction of the muscular membrane, and can cause vasodilatation of the intramural blood vessels [5]. Adrenergic innervation seems to play a similar role in the motor function of the cock *vas deferens*. Numerous adrenergic nerve fibres in the muscular membrane were described in the present study, with fewer observed in the mucosa [9]. There is no significant difference between the distribution of adrenergic nerve fibres in each part of the cock *vas deferens*. The largest number of adrenergic nerve fibres occurred in the muscle coat. Numerous adrenergic nerve fibres were associated with the small blood vessels.

The functional importance of cholinergic innervation of the mammalian *vas deferens* has not yet been well understood. Previous studies suggest that

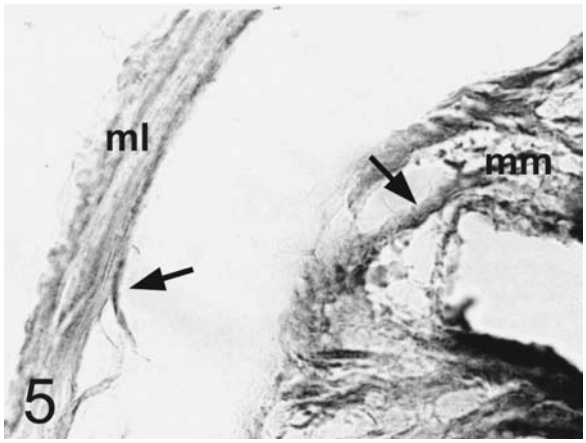

Figure 5. Central part of the *vas deferens*. AChE-positive nerve fibres in the muscular membrane and in the mucosa (× 200). Cholinergic nerve fibres in the chicken *vas deferens*. Abbreviations used in all figures; mm — mucosa, ml — muscular membrane. Arrows indicate nerve fibres.

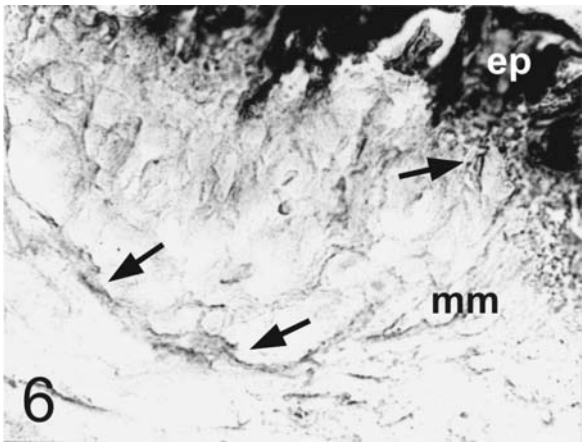

Figure 6. Central part of the *vas deferens*. Cholinergic nerve fibres in the mucosa. Single nerve fibres penetrating between epithelial cells (× 400). Cholinergic nerve fibres in the chicken *vas deferens;* ep — epithelium, mm — mucosa. Arrows indicate nerve fibres.

the main activity of cholinergic nerve fibres is to suppress adrenergic transmission [6, 8].

Cholinergic nerve fibres may act on the epithelial cells of the *vas deferens*. These cells may by responsible for fluid resorption from the lumen or for active secretion of some sperm component that may by necessary for sperm maturation [2]. Autonomic innervation of the avian *vas deferens* seems to play a similar role to that in the mammalian *vas deferens*. Cholinergic innervation was much weaker than the adrenergic innervation. It is associated with the muscular membrane as well as with the mucosa. The cholinergic nerve fibres in the cock *vas deferens* were located mainly under the mucosa.

Tingari [9] did not observe cholinergic nerve fibres in the close vicinity of blood vessels in the cock *vas deferens*. This is confirmed by the present study.

The present investigation demonstrates cholinergic nerve fibres penetrating between epithelial cells, which has not previously been observed in birds. It is worth noticing that nerve fibre penetration between epithelial cells has only been noted in the human *vas deferens* [5].

No previous publications have dealt exclusively with the innervation of the chicken *vas deferens*.

The present study generally confirms and expands the results of the previous studies of innervation of the cock genital tract conducted by Tingari and Lake [9] and Bennett and Malmfors [3]. The authors of both these investigations used the Falck-Hillarp method for adrenergic nerve visualisation. In the present study detection of adrenergic nerve fibres was performed using the de la Torre and Surgeon method.

The present publication may be an introduction to further studies on the autonomic innervation of the *vas deferens* in birds.

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