Herbst Corpuscles in the Smooth Muscles in the Wings of Chicks

In the wings of various passerine birds a discrete smooth muscle – the expansor secundariorum – is found[1]. The light microscopical anatomy of this muscle has been described by BERGER[1]. The muscle inserts on to several of the proximal secondaries, and on to the distal tertiaries in some species. The expansor secundariorum is remarkable, since it has an obvious tendon associated with it which inserts on to the humerus.

In the present study the muscle was found to be composed of bundles of smooth muscle cells comparable to those seen in the gizzard of the chick[2]. There were up to 50 smooth muscle cells in each bundle and the bundles were separated by small amounts of collagen. Although the expansor secundariorum is densely innervated by post-ganglionic adrenergic nerve fibres[3–5], in the present study single myelinated axons, 5–6 μm in diameter, were also seen running between the bundles of smooth muscle cells. These myelinated axons were traced towards the tendinous insertion of the muscle and were found to arise from typical Herbst corpuscles. Figure 1 shows a corpuscle embedded between muscle bundles lying 1 or 2 mm distal from the tendinous insertion.

The corpuscles were composed of 4 main parts: an outer capsule of collagenous material, a fluid filled outer core and an inner core composed mainly of cells that surrounded the axial nerve fibre. The structure of these various layers has been described in detail by QUILLIAM[6]; more recently SHANTHA and BOURNE[7] have suggested that the inner and outer lamellar cores are derived from the perineural epithelium of the nerve fibre.

The present study showed that the corpuscles were about 120 μm in diameter and 150–200 μm long. The terminal axon was 2–3 μm in diameter, but increased to about 5 μm at its distal tip. The axon (Figure 2) contained very numerous small mitochondria, irregular agranular vesicles and neurofilaments. There were several such corpuscles

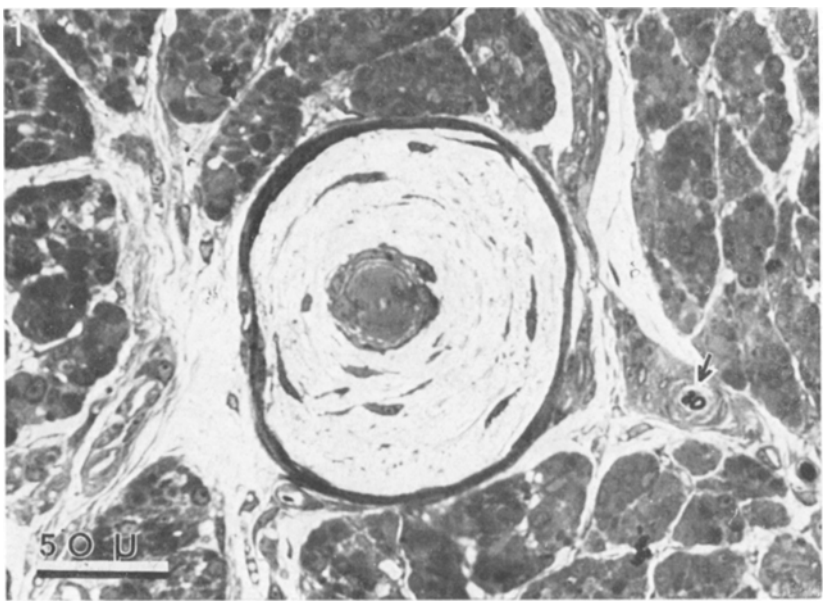

Fig. 1. Light micrograph of a Herbst corpuscle embedded between the smooth muscle bundles of the expansor secundariorum in the wing of a chick. Note the lamellate structure is surrounded by bundles of smooth muscle cells cut in cross-section. 3 myelinated axons are also present (arrow).

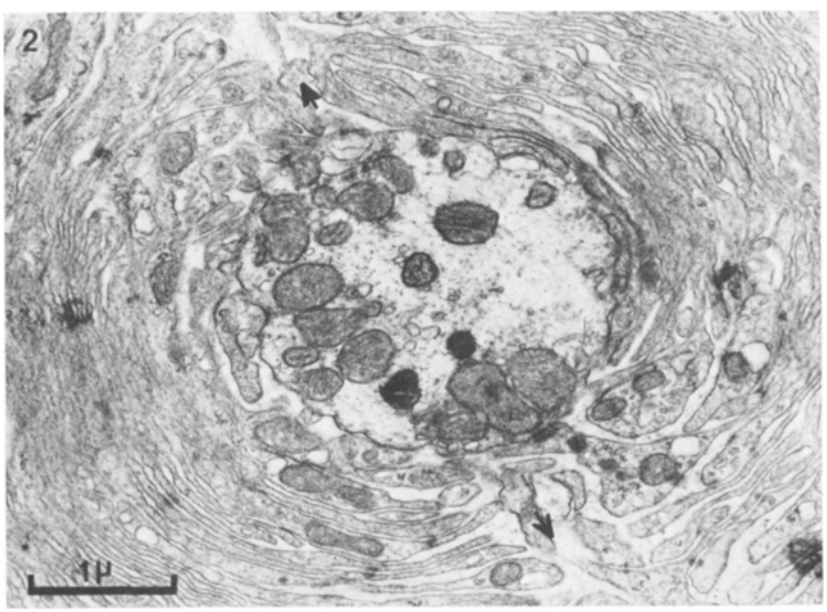

Fig. 2. Electron micrograph of the central axon of the Herbst corpuscle shown in Figure 1. Note the layers of tissue forming the inner capsule are separated, by a radial cleft, into 2 hemispheres (arrows).

embedded in the smooth muscle of the expansor secundariorum muscle of the chick; the myelinated axons that they gave rise to ran across the muscle and joined the brachial nerve supplying the wing.

It is currently considered that Herbst corpuscles and the similar Pacinian corpuscles of mammals are mechanoreceptors[6]. If this is true for the corpuscles in the expansor secundariorum muscle it seems likely that movements of the secondary wing feathers would be detected by the Herbst corpuscles which could play an important role in flight. Variations in the pitch of the secondary feathers and changes in the air flow over them due to manœuvring or to air currents encountered would be registered as alterations in the vibration frequency of these feathers. This information, relayed via the Herbst corpuscles, spinal cord and autonomic efferent fibres to the expansor secundariorum muscle could reset the pitch of the secondaries to suit their continually changing environment. This system may therefore be an example of the involvement of a lamellate type of receptor in a direct muscle reflex.

The peripheral nature of the expansor secundariorum muscle and the simplicity of the dissection needed to expose it should make it a suitable preparation for the in vivo study of this type of receptor.

Résumé. Les corpuscules de Herbst existent dans le m. expansor secundariorum de l'aile de la poule domestique. Il est possible qu'ils conditionnent l'action réflexe du muscle.

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1 A. J. Berger, J. Morph. *99*, 137 (1956).
2 T. Bennett and J. L. S. Cobb, Z. Zellforsch. *96*, 173 (1969).
3 G. A. Buckley and L. E. Wheater, J. Pharm. Pharmac. *20*, Suppl. 1145 (1968).
4 T. Bennett and T. Malmfors, Z. Zellforsch., submitted.
5 T. Bennett, G. Burnstock, J. L. S. Cobb and T. Malmfors, Br. J. Pharmac., in press.
6 T. A. Quilliam, CIBA Symp. *Touch, Heat and Pain*, p. 86 (1966).
7 T. R. Shantha and G. H. Bourne, in *Structure and Function of Nervous Tissue* (Academic Press, New York 1968), p. 380.
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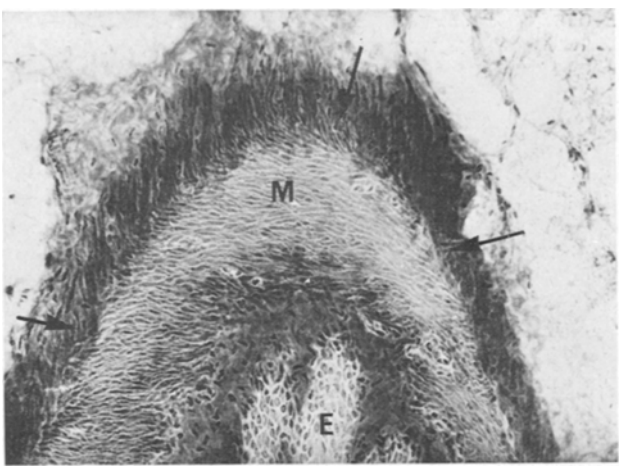
Atypical Muscle Cells in the Wall of the Renal Calix and Pelvis with a Note on their Possible Significance

Atypical muscle cells were first recognized in the wall of the renal calix by the present author and their fine structure has recently been described in the rat renal calix by Dixon and Gosling[1]. Similar cells have now been demonstrated in a number of species and this report is a brief description of their morphology when examined using light microscopy.

In all species examined (monkey, rabbit, guinea-pig and rat) atypical muscle cells are identified in the caliceal wall close to the renal parenchyma. These cells are smaller than the other (typical) smooth muscle cells identified in the wall of the upper urinary tract. Each cell is separated from its neighbours by a small amount of connective tissue; they are not grouped closely into bundles. Using Massons trichrome technique, the cytoplasm of atypical cells stain less well and their nuclei appear smaller than other smooth muscle cells. A continuous layer composed of atypical cells can be identified around the renal caliceal and pelvic wall lying on the external aspect of the muscle coat. The cells run at right-angles to the subjacent muscle to which they are closely related. They are arranged obliquely so that their long axes run towards the lumen (Figure). These cells extend across the renal pelvis as far as the pelvi-ureteric junction where they appear to end; similar cells could not be detected in the ureteric wall proper.

Using formalin fixed paraffin embedded tissues, atypical muscle cells are difficult to detect. Employing these techniques, the present author failed to describe these cells in a recent report on the musculature of the upper urinary tract[2]. This difficulty might explain why the cells have remained undetected in spite of many investigations on the region. The present study was based on cryostat sections cut from fresh tissues quenched in isopentane (previously cooled in liquid nitrogen).

The frequent association between nervous tissue and atypical muscle cells has been noted in the calix. Preliminary studies on the distribution of catecholamine containing nerves in the renal calix and pelvis of other species



An oblique section through the renal pelvis of the guinea-pig showing the epithelium (E) and pelvic muscle (M). The position of atypical muscle cells is indicated by the arrows. × 200.

1 J. S. Dixon and J. A. Gosling, Z. Zellforsch., in press (1970). J. A. Gosling, Acta Anat., in press (1970).