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Ventricular Nerve Cells in Mammals

It is widely believed that, in mammals generally, cardiac nerve cells are limited to the atria, extending at the most as far distally as the base of the ventricles near the atrioventricular sulcus. We have examined histologically the hearts of representatives of a number of orders of mammals, namely, Monotremes, Marsupials, Insectivora, Rodentia, Carnivora, Cetacea, Artiodactyla, Perissodactyla, Chiroptera, Menotyphla and Primates. In most of these, no nerve cells were found in the epicardium, endocardium or myocardium of the ventricles. Only in Cetacea and Artiodactyla (see later) are ventricular nerve cells abundant; literally, many thousands extend widely over both ventricles in the epicardium, and numerous nerve cells accompany the atrioventricular bundle and its right and left limbs in the ventricular endocardium, but are not found elsewhere in the endocardium or in the myocardium. In Perissodactyla, no nerve cells were found in the ventricles; the difference between Artiodactyla and Perissodactyla in this respect lends support to the modern tendency (based on other morphological differences) to discontinue the use of the term 'Ungulates' to include both these groups, and to raise both to equivalent ordinal rank. Among Artiodactyla, the Ruminants show a much more extensive distribution of ventricular nerve cells than do the Non-ruminants; in this respect the Cetacea resemble the Ruminants, a feature that supports other morphological evidence of affinity between these two groups.

Previous observers are agreed that in the atria of mammals the great majority of nerve cells are multipolar. Our study reveals that in the ventricles of Cetacea and Artiodactyla most of the nerve cells in the epicardium are bipolar or unipolar, multipolar cells comprising a minority; by contrast, the majority of cells related to the atrioventricular bundle and its limbs are multipolar, few being bipolar or unipolar. It is generally believed that all nerve cells in the heart (as in other viscera) are efferent parasympathetic in nature. Two observations have led us to wonder whether the bipolar or unipolar cells might be sensory (afferent) and the multipolar cells efferent; namely, (1) in many cases we noted that the single process of a unipolar cell divided into two some distance from the cell body, such cells thus resembling the pseudo-unipolar cells of the spinal and cranial nerve ganglia; and (2) whereas we observed the endings (synapses) of nerve fibres in relation to the cell bodies and processes of the multipolar cells, we have not found any nerve endings about the bipolar and unipolar cells. We have some degeneration experiments in hand in the hope of obtaining further information on this question.

Osmic preparations showed the presence of numerous medullated nerve fibres, of various sizes and thickness of myelin sheath, in the ventricular epicardium and endocardium. In neither situation were elaborate nerve endings seen, the nerves ending by simply coming to an end or by having simple bulb-like enlargements at their extremities. In relation to the ventricular cardiac muscle fibres, fine nerves end by forming spirals around individual muscle fibres; they do not penetrate into the muscle fibres, and we have failed to find anything resembling muscle spindles of voluntary muscle (which are very elaborate neuromuscular complexes).

We submit that the nerve spirals around the myocardial fibres are probably sensory in nature and could well be the anatomical arrangement that could serve as stretch receptors in the ventricular myocardium. We have not found any nerve endings that could be interpreted on morphological grounds to be motor endings in relation to the cardiac muscle fibres. In the case of the Purkinje fibres of the atrioventricular bundle and its limbs, however, we have observed two types of nerve endings: (1) a fine plexus on the surface of the Purkinje fibres, which may be sensory in nature; and (2) a series of simple knob-like endings on the surface of the Purkinje fibres, which we suggest are motor endings. Neither the endings related to the myocardial fibres, nor those related to the Purkinje fibres, are extremely numerous, and it appears to us that their relative paucity may be correlated with the syncytial nature of the heart musculature.

A full account of this work, with a survey of the extensive literature, will be published elsewhere.

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Development of Resistance to Dihydrostreptomycin by *Bacterium coli*

The development of populations of bacteria showing increased resistance to drugs is usually assumed to be the result of: (1) a continuous increase in resistance as a result of interaction between drug and cell[1], that is, adaptation, or (2) a discontinuous increase due to selection of a few resistant cells either already present[2] or induced by the drug[3], that is, spontaneous or induced mutation.

Our experiments indicate that with regard to dihydrostreptomycin both these processes may be involved. By exposing a strain of *Bacterium coli* to a range of concentrations of the drug in a glucose synthetic medium (glucose 10 gm. (sterilized separately), KH_2PO_4 3 gm., K_2HPO_4 6 gm., NH_4Cl 1 gm., $MgSO_4.7H_2O$ 25 mgm., $FeSO_4.7H_2O$ 2·5 mgm., distilled water 1 litre) a striking and consistent pattern has been observed.

The experiments were of two types: (*a*) 'progressive training' by using the organisms growing in the highest concentration of dihydrostreptomycin, excluding 'wild plus' growths (see below) as the