Neurohistological Observations on the Oesophageal Innervation of Rabbit*

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Summary. The vegetative, motor, and sensitive innervation of the oesophagus of rabbit was studied by means of several neurohistological techniques. A great deal of vegetative and somatic nervous formations were found and described within the various segments of the organ; namely at level of the cervical, thoracic, prediaphragmatic, and abdominal oesophageal tracts. In particular, isolated and grouped ganglion cells, interstitial and associative neurons, free nervous terminations, and an amylminated subepithelial network sending delicate fibrils to the basal layers of the impending epithelium were described. The vegetative nervous component is organized into an extramural oesophageal plexus, and into an intramural one. The numerous motor endplates lying on the striated muscle fibres show different forms and several other structural peculiarities. The sensitive terminations are represented by simple and non-capsulated Ruffini's corpuscles contained within the submucous connective tissue. The possible functional correlations of these morphological findings are discussed.

Introduction

The literature concerning the structure and the innervation of the oesophagus in mammals even if it is abundant, still not fully solved remain some morpho-functional and morpho-pathological problems mostly related to the proximal and distal junctional zones of the organ. It seems likely that a close relationship may be mainly between the nervous component of the oesophagus and the various mechanisms operating in its normal and pathological functions as well. That is the reason why in this paper we have directed our attention to the occurrence and the morphology of the vegetative, motor, and sensitive nervous structures present in the oesophagus of rabbit.

Material and Methods

For the present study ten adult and healthy rabbits of both sexes and weighing about four pounds each were utilized. From each animal two pieces were taken from the cervical, thoracic and abdominal parts of the oesophagus. Each piece was cut in two halves, one of which was subsequently divided and fixed in both Bouin and 5% buffered formalin, embedded in paraffin, suitably sectioned and stained with several common histological or special neurohistological methods, that is, among others Ematoxilin-eosin, Mallory-Azan, and Bodian's protargol methods. The second half of each piece was freshly prepared following the gold chloride method of Ruffini (1902). The specimens were examined and pictures taken with a light and phase contrast Zeiss Photomikroskop.

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Observations

The vegetative innervation of the rabbit's oesophagus is organized in a continuous series of plexus laid one upon the other, and originated by branches of both vagal and sympathetic nerves. They are specially prominent within the muscular layer, but evident also in the submucous stratum, as well as in the superficial adventitial and subserous tissues of the organ. In the former one they constitute a plexus similar to the Auerbach's myenteric one, but differing from it for the presence of myelinated nerve fibres besides the unmyelinated ones, according to the first finding of Ranvier (1880).

The intramuscular plexus of the rabbit's oesophagus is very evident in our material, and present as an almost continuous nervous layer in the cervical, thoracic, as well as in the abdominal tracts of the organ. Images of it are respectively seen in Figs. 1, 2, and 3. This plexus is made up with unmyelinated and myelinated nerve fibres, and with ganglion and interstitial cells. This finding disagrees with that of Irwin (1931), who excluded the presence of an intramuscular plexus in the oesophagus of guinea-pig, and sustained its presence only in the lowest oesophageal tract, within the smooth muscle fibres. Undoubtedly, in a species of rodents very close to guinea-pig's, that is in the rabbits as demonstrated more recently by one of us (Califano, 1966), the muscular oesophageal layer is formed by striated fibres only that arrive up to the junctional gastro-oesophageal tract. Moreover, it contains a conspicuous and nearly continuous myenteric plexus. On the other hand, this plexus was already described by de Witt (1900), Sabussow (1913), Temesrekasi (1956), and recently by Rash and Thomas (1962) in guinea-pigs, rats and rabbits. These last authors affirmed that very few nerve cells are contained within the myenteric plexus of the oesophagus, and they appear more numerous in the lower segment of the organ. According to the latter authors, as well as to Irwin (1931) and Matsuo (1934), also in our material the highest number of neurons are present at level of the diaphragmatic tract, where they can be seen following one another as really long neuronal chains (Fig. 3). But it must be emphasized that the finding of neurons within the myenteric plexus of the cervical and thoracic tracts, as showed in Figs. 1 and 2, is frequent too. In fact, in both of these last regions of the oesophagus isolated ganglion cells can be found contained within bundles of nerve fibres (Fig. 5), or they can lie in the meeting points of the fibres constituting the meshes of the plexus. Autonomic interstitial neurons (Fig. 6) can be seen within the meshes originated by the crossing nerve fibres of the plexus.

A less conspicuous amount of nerve plexus elements provide the outermost coat of the oesophagus and the submucous layer. In the former one, according to Rash and Thomas (1962), the branches deriving from both vagal and sympathetic nerve trunks give rise to a relatively abundant deal of fibres interlacing each other to form a real nerve plexus. It is more evident at level of the lower third of the organ; it contains isolated or bundled axons and ganglia which are generally made up by numerous nerve cells (Fig. 4). We could never demonstrate the presence in it of isolated autonomic neurons. Because of its location we called it extramural oesophageal plexus, and it can be considered analogous to the intestinal subserous plexus of Auerbach.