Glial Cells in the Myenteric Plexus

G. GABELLA

Department of Anatomy, University of Turin

(Z. Naturforsch. 26 b, 244—245 [1971]; received September 3, 1970)

In the myenteric plexus of rat stomach, ileum, and rectum, glial cells outnumber nerve cells by more than 3 to 1; they have several processes, extensively branching, which extend between, and adapt themselves to, other cellular elements, constituting a very compact structure. The most prominent feature of glial cell cytoplasm are bundles of glio filaments. No basement membrane surrounds individual glial cells; a single basement membrane is observed around the whole ganglion. Morphological features do not support the identification of these cells as Schwann cells, but relate them to the central nervous system astrocytes.

Intramural nerve plexuses of the gastro-intestinal tract are richly supplied with glial cells. The term 'Schwann cells' is generally used — both in the optical and electron microscopical accounts of the intestinal plexuses — to designate these cells, since they were considered similar to the cells ensheathing nerve fibres in other parts of the peripheral nervous systems.

Material and Method

The present observations were carried out on the myenteric plexus (Auerbach's plexus) of the stomach (glandular portion), ileum (second last loop) and rectum of adult albino rats. Specimens were fixed in 4.5% glutaraldehyde in phosphate buffer at pH 7.4, for 2.5 hrs, postfixed in osmium tetroxide 1.25%, dehydrated and embedded in Araldite. Ultrathin sections, stained with uranyl acetate and lead citrate, were examined in a Siemens electron microscope (Elmiskop 1A).

Results and Discussion

A general view of a section through a ganglion of the myenteric plexus is shown in Fig. 1*. The ganglion appears as a very compact structure, completely surrounded by a basement membrane and isolated from the connective tissue. All spaces are occupied by nervous or glial structures, with an intervening 'gap' of a few hundred Å between adjacent membranes, and the impression is one of intimate and complex intermingling of nervous and glial cells, as was clearly pointed out in the early accounts of the ultrastructure of the myenteric plexus.

Taking the average over all the full section montages, glial nuclei appear to outnumber neuron nuclei in a ratio of about 3 to 1; but, since the glial nuclei are smaller than those of the neurons, the ratio between glial cells and neuron should be higher; moreover, the ratio will be found still higher if the connective strands of the plexus are also taken into account, where glial cells are present and nerve cell bodies are usually absent.

Glial cell nuclei are oval; they often show indentations of the surface in the form of notches or of folds with parallel sides or with a constriction at the mouth, like a bottle-neck. The electron density of nuclei of glial cells is higher than nuclei of nerve cells.

The cytoplasm of the glial cell has large irregularly shaped fine processes which extend between the other cellular elements. The glial processes may be cylindrical, prismatic, or lamellate. Nerve profiles in cross section are oval or round and glial processes fit between them with a more irregular shape. Thin layers of glial folds may surround perikarya or nerve processes; on a few occasions a lamellar arrangement of the glial sheets was seen.

* Figs. 1—3 see Table pag. 246 a.
but myelin sheaths were never observed. However, this ensheathing by glial cells is by no means complete, and large portions of perikarya and dendrites at the surface of the ganglion are in direct contact with the basement membrane \(^3,4\) (Fig. 1). No basement membrane surrounds the individual glial cells; as mentioned before a single basement membrane is observed around the whole ganglion.

In the cytoplasm of the glial cell, mitochondria, Golgi complex, ribosomes, rough endoplasmic reticulum, lysosomes, microtubules, and glycogen granules occur. Centrioles are frequently observed. The most prominent feature, both in glial cell bodies and in glial processes, are bundles of filaments (gliofilaments) (Figs. 2 and 3); they have an indefinite length, are circular in cross section, with a diameter of 110 – 130 Å.

The typical shape, with several processes extensively branching and adapting themselves to the spaces between the other profiles, and the occurrence of bundles of gliofilaments, do not support the identification of these cells as Schwann cells; neither do so the occurrence of a single basement membrane, around the whole ganglion but not surrounding individual glial cells. Some morphological features relate them to the central nervous system astrocytes \(^8,9\); in the central nervous system gliofilaments and glycogen granules provide unequivocal signs of identification of astrocytes \(^10,11\). In the myenteric plexus the labyrinthine complexity of glial processes and the occurrence of gliofilaments are probably related to the intense mechanical stimulation of the intramural ganglia. With the contraction of the gut wall (e.g. during peristalsis) the shape of the ganglion is completely altered, and this must be accompanied by a deformation of the internal constituents which possibly slide over one another. Thus the glial cells have an important mechanical function, giving mechanical support and permitting the sliding of the nervous structures \(^12,13\).

\(^8\) For a general account of the ultrastructure of the central nervous system glial cells see: E. MUGNAINI and F. WÄLBERG, Ergebn. Anat. Entwickl. 37, 194 [1964].

\(^9\) This is not to exclude the presence in the myenteric plexus of a minor number of glial cells of a different type; actually, in the rectum glial cells closely resembling oligodendrocytes of the central nervous system were observed.

\(^10\) L. KRUGER and D. S. MAXWELL, Amer. J. Anatomy 118, 411 [1968].


\(^12\) I am grateful to Prof. E. G. GRAY, University College London, for very kindly reading the manuscript.

\(^13\) Present address: Department of Anatomy, University College London.