MORPHOLOGICAL STUDY ON THE MOTILITY OF THE HUMAN COLON

Norimasa NARITA, M.D.*, Kiyoshi KAWAKAMI, M.D.*, Yutaka YOSHIDA, M.D.* and Goyo KOYA, M.D.**

*First Department of Internal Medicine, Hirosaki University School of Medicine, Hirosaki, 036 Japan
**Department of Pathology, Institute of Cerebrovascular Diseases, Hirosaki University School of Medicine, Hirosaki, 036 Japan

Summary

We tried to make a clear three-dimensional picture of the autonomic nerves in the wall of the human colon, using a Golgi method rarely applied to human materials. At autopsy, sigmoid colon without mucosal lesions were collected from 16 males after sudden death from apoplexy, head injury, or myocardial infarction. These materials were fixed in 10% formalin, impregnated with a modified Golgi method and embedded in celloidin. Then three-dimensional serial sections were made and observed with a light microscope. Many fine nerve fibers formed a plexus in the subserosa, muscular layer, submucosa, and mucosa. The myenteric plexus was made up of rectangular meshes of nerve fiber bundles. However, unlike myenteric plexus, no regular mesh was found in the submucosal plexus. Further, nerve fibers connecting myenteric and submucosal plexus were observed. It may be concluded from these findings that there exist nerve pathways regulating intestinal motility between myenteric and submucosal plexus.

Key Words: intrinsic nerves, Golgi method, three-dimensional picture, human colon.

Introduction

A large number of electrophysiological studies have been performed on the mechanism of intestinal motility especially on intrinsic nerves in the intestinal wall, as well as the extrinsic nerves from the brain and spinal cord. Variations in nerve pathways connecting myenteric and submucosal plexus were detected by Fukuhara et al.1) and Schofield2) from the results of electrophysiological experiments.

From a morphological point of view, brain-gut peptides such as substance P and vasoactive intestinal polypeptide (VIP) are observed in the intestinal wall by immunohistological studies, in addition to cholinergic and adrenergic neurons3,4).

Clinical approaches to intestinal motility, on the other hand, are almost always limited to the electromyogram and measurement of intraluminal pressure in normal man and patients with irritable colon syndrome or diverticular disease5-9).

Hitherto adopted morphological methods to study the nervous system of the intestine, e.g. dye-staining, silver impregnation, histochemistry and electron microscopy, are not good
enough for observation of the complete neural structure. Therefore we tried to make a clear three-dimensional picture of the autonomic nerves in the wall of the human colon, using a Golgi method rarely applied to human materials. We used instruments to achieve more stable silver impregnation with the modified Golgi method for formalin-fixed materials reported by Braitenberg et al. With these new devices, we succeeded in observing the intrinsic nerves of the human colon.

Materials and Methods

Sigmoid colon without mucosal lesions was collected at autopsy from 16 males aged 24 to 68, who suddenly died of apoplexy, head injury, or myocardial infarction. Materials were fixed in 10% formalin and impregnated with our modified Golgi method. After impregnation, the tissue blocks were embedded in celloidin and hardened in a few days by alcohol-chloroform solution. Then three-dimensional serial sections of 50–80 μm were made, cleared by toluene and xylene, mounted with xylene-balsam, and observed with a light microscope.

Results

In normal colon, fine nerve fibers were observed forming plexuses in the subserosa, longitudinal and circular muscles, submucosa, and mucosa.

1. Subserosal plexus

In the subserosa, extrinsic nerve fibers were found extending to the longitudinal muscles. These nerve fibers formed subserosal plexuses.

2. External muscular plexus in the longitudinal muscles

Nerve fibers extending vertically from subserosa to the longitudinal muscles terminated at the muscle cells.

3. Myenteric plexus

Parallel to the serosa, bundles of fine autonomic nerve fibers made large rectangular meshes between longitudinal and circular muscles. Above regular nerve fiber bundles, fine nerve fibers were distributed to the circular muscles (Fig. 1). At the intersections of nerve fiber bundles, small meshes were observed extending vertically from longitudinal to circular muscles. Other nerve fibers radiated horizontally from nerve fiber bundles toward muscle

Fig. 1. Myenteric plexus. Over the nerve fiber bundles, fine nerve fibers are distributed to the circular muscles (×96).

Fig. 2. Internal muscular plexus. In the circular muscles, many nerve fibers connect the myenteric (lower part of the photo) and submucosal plexuses (upper part) (×48).