MICROCIRCULATORY BED OF HUMAN ESOPHAGEAL MUCOSAL EPITHELIUM DURING POSTNATAL DEVELOPMENT

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The process of development of the mucosa and its components, including the microcirculatory bed, is an inseparable part of the organogenesis of the esophageal wall [1-4, 7-9]. However, research workers have paid too little attention to the development and formation of the microvascular bed of the epithelial layer of the mucosa. Information on the structure of the microcjrculatory bed of the epithelial layer is important for oncologic and surgical practice [5, 6, 10].

This paper describes a morphological investigation of the microcirculatory bed of the epithelial layer of the human esophageal mucosa during postnatal development.

EXPERIMENTAL METHOD

The microcirculatory bed of the epithelial layer of the mucosa was studied in 2400 serial preparations obtained from the pharyngoesophageal, aortic-bifurcational, and esophagogastric segments of the normal human esophagus. Histological sections were stained by the methods of Van Gieson, Foot, Mallory, Kupriyanov, and Bielschowsky. The microscopic sections were photographed on a "Reichert" microscope.

EXPERIMENTAL RESULTS

Four types of capillary networks can be distinguished in the epithelial layer of the esophageal mucosa (Fig. 1): I) superficial looped, II) deep looped (Fig. 2), III) superficial glomerular, and IV) deep glomerular (Fig. 3). The type I capillary network penetrates as far as the level of the middle part of the stratum spinosum of epithelial cells, type II to the level of the surface layer of squamous cells; type III lies at the level of the middle part of the stratum spinosum of the epithelium, and type IV reaches the layer of superficial squamous cells. Types I and II of capillary networks are formed by capillaries of the microcirculatory bed of the connective-tissue papillae of the mucosa, and in other cases by capillaries penetrating into the thickness of the epithelium immediately from the connective tissue of the tunica propria of the mucosa. Types III and IV of capillary networks are formed mainly by capillaries branching from microvessels of the connective-tissue papillae of the tunica propria of the mucosa. Where capillary networks, especially of types II and IV, are located the cytoarchitectonics of the epitheliocytes is altered: the thickness of the stratum spinosum and its stratification are reduced (to four or five rows of cells). To the unaided eye, this phenomenon appears as evagination of the epithelium into the lumen of the esophagus.

The formation of superficial and deep types of looped capillary networks in the epithelial layer of the mucosa has a dynamic, age aspect. In particular, the epithelial layer of the esophageal mucosa from birth until the age of 3 years possesses capillary netwozks of types III and IV. Between the ages of 3 and 12 years capillary networks of all four types are present. From 12 to 20 and from 20 to 30 years of age capillary networks of types I and II predominate and they are formed mainly on account of the microcirculatory bed of connective-tissue papillae.

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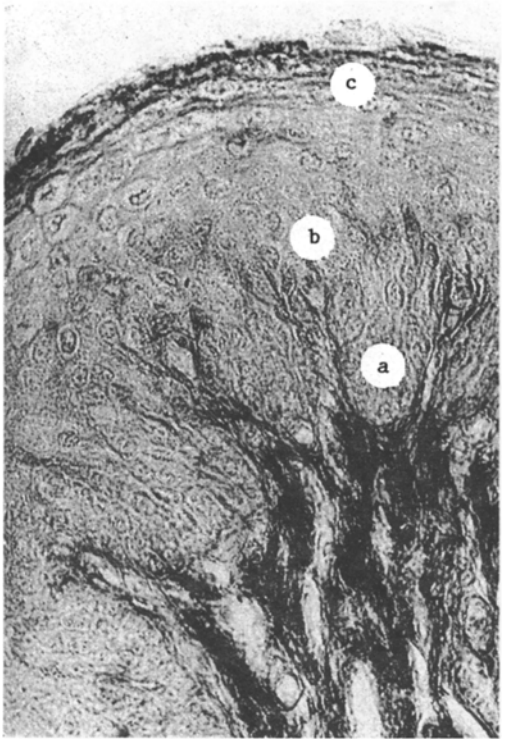

Fig. 1. Epithelial layer of mucosa of esophagogastric segment of esophagus of a person aged 40 years. a) Basal cells, b) intermediate (prickle) cells, c) desquamated cells. Stained by Bielschowsky's method. 60×.

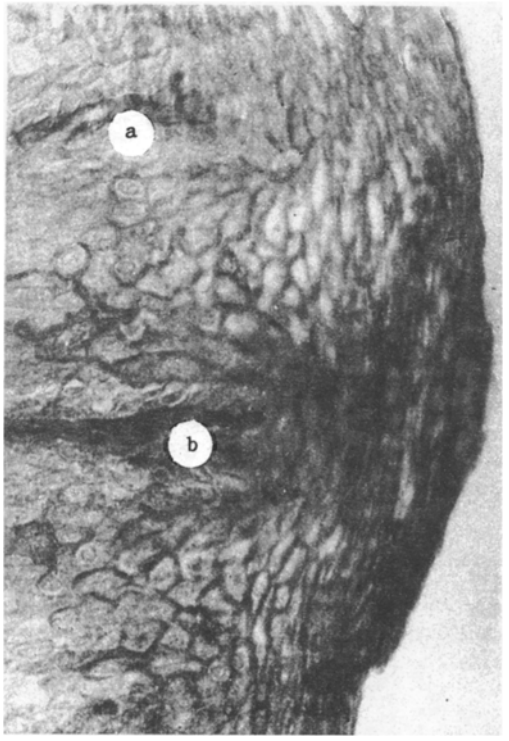

Fig. 2. Capillaries of epithelial layer of mucosa of pharyngoesophageal segment of esophagus of a child aged 2 years. a) Looped superficial capillary, b) looped deep capillary. Stained by Foot's method. 150×.

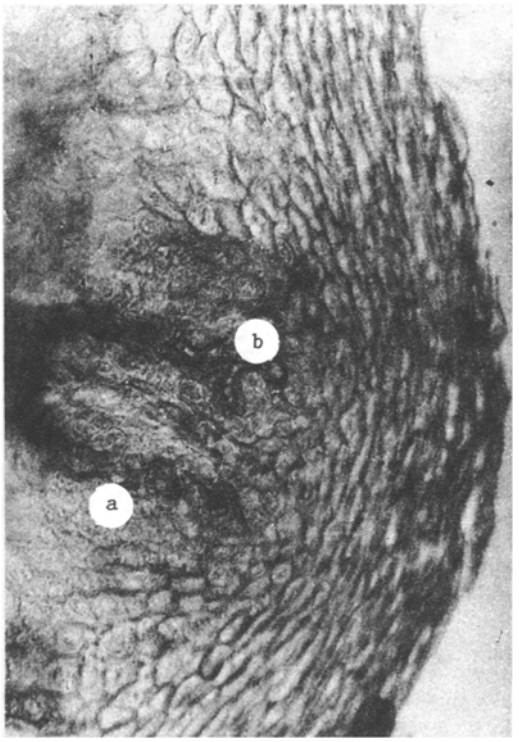

Fig. 3. Capillaries of epithelial layer of mucosa of aortic bifurcational segment of esophagus of a person aged 29 years. a) Superficial glomerular capillary, b) deep glomerular capillary; stained by Bielschowsky's method. 150×.

At the age of 40 to 50 years and, more especially, over 50 years of age capillary networks of types IV and III predominate, and this is closely linked with atrophy of some of the connective-tissue papillae, as is shown by the constant increase in the distance between them. At this age dynamic atrophy of structures of the microcirculatory bed and signs of sclerosis of connective tissue are observed in the tunica propria of the mucosa.

Besides the age changes in the microcirculatory bed of the epithelial layer of the mucosa, noted above, the topographic features of arrangement of the capillary networks of the epithelial layer along the whole length of the esophagus also are sufficiently clearly demonstrated. For instance, in the pharyngoesophageal and esophagogastric segments capillary networks of the I and III types predominate, whereas the aortic-bifurcational segment is characterized by capillary networks of types II and IV. Meanwhile processes of involution (atrophy of the capillary networks, a decrease in the volumes of the connective-tissue papillae, and an increase in the distance between them) reach the aortic bifurcational segment much later. They are also more marked in the esophagogastric segment, where varicose dilatation of the venules and veins of the intramural vascular bed of the esophageal wall and signs of atrophy and sclerosis of the connective tissue are more evident.

Thus the development and formation of the epithelial layer of the mucosa and of its microcirculatory bed are linked processes. The time course of the morphological changes corresponds strictly to the stages of individual development of the organ. The successively changing types of capillary networks, moreover, reflect the degree of maturity of the microcirculatory bed of the epithelial layer of the mucosa at each age stage of postnatal organogenesis.

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EFFECT OF BURNS ON ULTRASTRUCTURE OF THE GANGLIA NODOSA

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Burn trauma leads to severe structural and functional disturbances of all organs and systems of the human body [6, 11, 12]. According to data in the literature, in burns all parts of the central and peripheral nervous system are involved in the pathological process [2, 7-9]. Light-optical studies of autonomic ganglia in various diseases, including burns, have shown combined lesions including, on the one hand, atrophic and degenerative changes, and on the other hand, compensatory and adaptive changes [1, 3-5, 10]. The paucity of information on ultrastructural changes in autonomic ganglia in burns is highly characteristic of this condition, more especially because the use of classical neurohistological methods of investigation has shown that the nervous system plays an important role in the pathogenesis of the burn syndrome [2, 4, 5, 7]. The aim of this investigation was to study ultrastructural changes in the ganglia nodosa of the vagus nerves at different stages of burn trauma.

EXPERIMENTAL METHOD

The investigation was conducted on autopsy material from 30 persons dying at different periods of burn trauma (shock, toxemia, septicotoxemia, burn cachexia), and 10 hitherto clinically healthy persons dying accidentally. The victims were from 14 to 75 years of age. Autopsy was carried out soon (1-3 h) after death. The test objects were the ganglia nodosa of the vagus nerves. Material was fixed in 1% glutaraldehyde solution and postfixed in buffered 1% osmium tetroxide solution, dehydrated with alcohols, and embedded in a mixture of Epon and Araldite. Sections cut on an LKB-4801A Ultramicrotome were stained in uranyl acetate and counterstained with a solution of lead monoxide and studied in the JEM-100B electron microscope. Material for histological study was fixed in 10-12% neutral formalin and embedded in paraffin wax. Sections were stained with hematoxylin and eosin, with picrofuchsine by Van Gieson's method, and also by Nissl's method.

EXPERIMENTAL RESULTS

Histological investigation revealed marked congestion of capillaries and ectasia of the lymphatics. In sections stained by Nissl's method degenerative changes were observed in the ganglion cells in the form of swelling of neurons and their central and total chromatolysis. In most neurons the chromatophilic substance was in a state of solution or was diffusely scattered in the cytoplasm in the form of tiny granules. In some neurons the chromatophilic substance was located at the periphery of the cells in the form of single small clumps, but sometimes it was concentrated around the nucleus. Neurons with total chromatolysis also were found. Degeneratively changed nerve cells, in a state of necrobiosis, often were undergoing neuronophagy by satellite cells and connective-tissue cells, especially in the later stages of burn trauma.

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