PHAGOCYTIC FUNCTION OF THE EPITHELIUM OF THE SEMINIFEROUS PASSAGES IN ALBINO RATS DURING REPARATIVE REGENERATION

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After injury to the epididymis in albino rats, participation of the epithelium of the vasa efferentia of the testis and duct of the epididymis in resorption of the contents of the tubules by phagocytosis was observed. As a result of fusion, giant multinuclear epithelial cells are formed.

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The widespread nature of the phenomena of phagocytosis is well known, but there is little information on the phagocytic function of epithelial tissues. Phagocytosis has been observed in inflammatory growths of the epidermis [2] and the renal epithelium [5]. It has been claimed that at least some of the alveolar macrophages in the lung are of epithelial origin [1]. Phagocytosis of residual particles by Sertoli cells has been described in the testis [16, 20], and phagocytosis of degenerating spermatogenic cells [8] and ink particles [19] by the epithelium in the epididymis.

During phagocytosis by connective-tissue macrophages, giant multinuclear cells are frequently formed by fusion of mononuclear cells [4, 6]. Giant epithelial cells have been observed in the lungs of children with measles [11], and in the epidermis after transient freezing of the skin [9, 12].

The entry of spermatozoa into the interstitial tissue of the testis of epididymis induces a spermatozoal granuloma with the formation of multinuclear macrophages and phagocytosis of the spermatozoa [13, 14, 17, 21, 22]. Giant phagocytic cells have been observed inside the seminiferous tubules in granulomas of the testis [18], but their origin has not been fully explained; dedifferentiation and slight proliferation of the epithelium have been reported in the epididymis [15]. Disturbance of the barrier between the spermatogenic cells and interstitial tissue leads to autoimmunization, one result of which may be degeneration of the spermatogenic epithelium [10].

In the course of a study of reparative regeneration of the epididymis, we observed well-marked phagocytic activity of epithelial growths of the vasa efferentia of the testis and duct of the epididymis.

EXPERIMENTAL METHOD

Experiments were carried out on 25 adult male albino rats subjected to mechanical trauma (incision with a scalpel) of the epididymis in the region of the vasa efferentia and duct of the epididymis. The experiments were carried out from 10 h to 3 months later. Material for histological examination was fixed in 10% formalin and embedded in paraffin wax.

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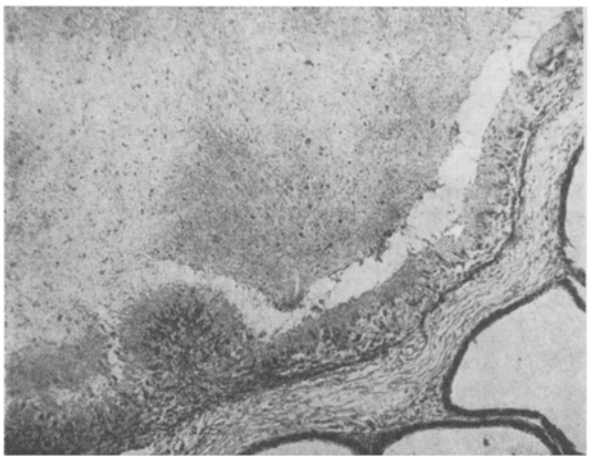

Fig. 1.

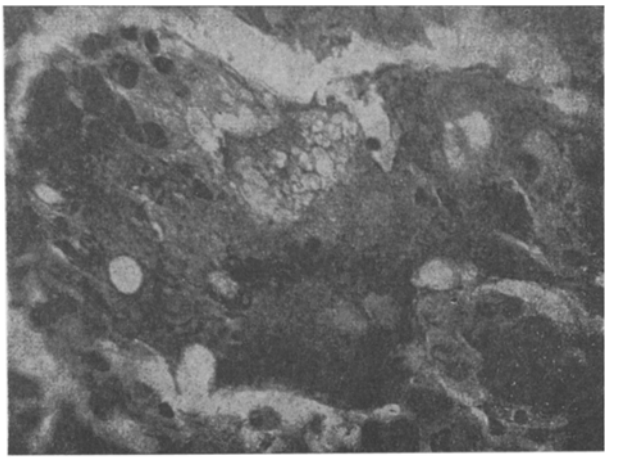

Fig. 2.

Fig. 1. Epithelized cyst lined by epithelium of the duct of the epididymis (time of experiment 25 days). Van Gieson, 90 ×.

Fig. 2. Giant epithelial cells in cyst wall. Granules, vacuoles, and solitary spermatozoa in cytoplasm (time of experiment 42 days). Heidenhain's iron hematoxylin. 600 ×.

EXPERIMENTAL RESULTS

Transient acute inflammation developed after trauma. The exudative phenomena subsided after 2-3 days and were followed by a phase of proliferation, which was largely complete in 7-8 days. The wound healed, but differentiation of the connective tissue and epithelium took place more gradually.

After trauma the contents of the tubules entered the wound and were encapsulated. The differentiated epithelium of the injured vasa efferentia of the testis and duct of the epididymis covered the inner surface of the capsule as it grew. Epithelized cysts were thus formed (Fig. 1). In addition, in the proliferative phase, inflammatory growth of the tubular epithelium was observed at the site and infiltrative growth in the immature connective tissue.

During growth in the tubules at the site of injury and in the cysts, the differentiated epithelium came into contact with the contents present in the lumen, which were the ordinary contents of the tubules with the addition of exudate and breadkdown products. Spermatozoa were present in them. Under these circumstances on the 5th-7th day of the experiment the epithelium had the appearance of loose sheets consisting of several layers of cells, connected by processes of cytoplasm. Because of the loose connections and irregular arrangement of the cells, no conclusion could be drawn regarding true stratification of the sheets. The cells were irregular, round, or elongated in shape. The nuclei varied in size and shape and in the size of their nucleoli. Large cells with a low content of nucleic acids, pale cytoplasm, and a large, vesicular nucleus, were predominant. Among them were binuclear cells, which are also present in the normal lining of the tubules [19].

Starting on the 5th-7th day of experiment, smaller, irregular cells were found in the depth of the epithelial layer, near its border with the connective tissue. These cells increased in size toward the surface, and some of them were elongated in the vertical direction. The nuclei of the superficial cells usually lay nearer to the basal part, and the cytoplasm of the apical parts was in close contact with the contents of the cysts or tubules, and appeared confluent with them. In addition, the boundaries between some neighboring cells disappeared, giving the impression that groups of cells were fused to form syncytia, with a few and sometimes many nuclei (Fig. 2).

Various types of inclusions appeared in the cytoplasm of the mononuclear and giant multinuclear cells. Granules, vacuoles, pale filaments of spermatozoa, and less frequently their heads were found (Fig. 2). After staining by Van Gieson's method and with Heidenhain's iron hematoxylin, the granules and filamentous structures stained a grayish color, and black granules and filaments were more rarely seen. Granules and filaments stained pink with azure II-eosin, and sometimes azurophilic granules were found. When

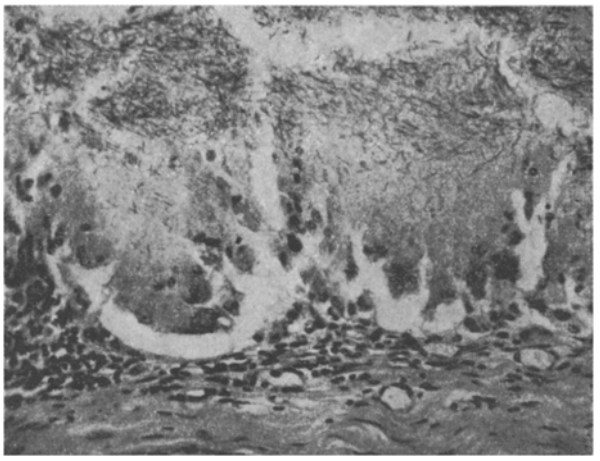

Fig. 3. Budding of giant epithelial cells in cyst wall (time of experiment 42 days). Heidenhain's iron hematoxylin, 300 ×.

stained by Mallory's method, the granules and filaments appeared yellow, but deep granules also were found. With the PAS reaction the granules appeared pale pink, and only in a few large cells was a homogeneous bright red mass seen. Hence, by the use of different staining methods, the heterogeneity of the material in the cytoplasm of the epithelial cells was confirmed.

It must be concluded from the phenomena described that the epithelium participates in resorption of the contents of the tubules and cysts. The liquid material contained in the vacuoles may enter the cells by pinocytosis, but solid particles (fragments of spermatozoa) are evidence of phagocytosis. Resorption takes place over a long period and was not complete at the latest stage of the experiment (3 months). However, after 1.5 months, in some places the gradual separation of phagocytic epithelial cells could be observed from the deep cell layer located on the connective tissue, differentiating into a single-layered sheet of cells of the original type (Fig. 3).

Consequently, during inflammatory and regenerative growth the dedifferentiated epithelium of the vasa afferentia of the testis and duct of the epididymis exhibit a resorptive (phagocytic) function with the formation of multinuclear giant cells. This observation confirms that phagocytosis is a biological phenomenon characteristic not only of specialized blood, connective tissue, and neuroglial cells, but also of epithelium.

For the epithelium of the epididymis the resorptive function is a physiological function, and the contents of the cysts and tubules which underwent resorption are to some extent physiological. At the same time, the removal of breakdown products from the tissues after injury is an inflammatory function [3]. Phagocytosis by the epithelium of the seminiferous pathways under these experimental conditions can thus be regarded as an inflammatory reaction of cleansing of the tissues, based on exaggeration of a physiological function.

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