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Experimental Morphological Analysis of Surgical Bypassing of the Uveal Tract

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Histological preparations of eyeball membranes from rabbits subjected to decompression multisclerectomy providing alternative drainage pathway were examined. The procedure was performed with or without application of a 5-fluorouracil-impregnated implant. The use of this implant always resulted in the formation of relatively wide endothelialized transscleral channels and ensured their persistence in the late postoperation period.

Key words: *uveal tract; multisclerectomy; 5-fluorouracil-impregnated implant*

Several types of surgical compensatory treatment for pathological conditions of the eyeball membranes [1-5] have been proposed. We analyzed the results of organ-conserving surgical procedures including perforation of the sclera without damaging the uvea and retina with and without application of a biocompatible cytostatic implant.

MATERIALS AND METHODS

The study was performed on eyes of 12 male Chinchilla rabbits. In 6 rabbits (group 1) sclerectomy was followed by application of an implant wetted with one drop of 5% solution of the cytostatic drug 5-fluorouracil (5-FU); the total dose of 5-FU was 1.25±0.25 mg. In group 2 rabbits the procedure was performed without applying the cytostatic-impregnated implant.

The surgery was performed under general anesthesia (20-40 mg/kg ketamine hydrochloride and 1-2 mg/kg diazepam i. m.) with retrobulbar administration of 1 ml 2% procaine by means of a trephine of 1.5 mm in diameter.

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The conjunctiva was sectioned and separated along the limbus in the lateral segment of the eyeball. The tendon of the lateral rectus muscle was isolated and suspended on a ligature. The sclera was perforated at two to four sites under the muscle and 2×2×4 mm fragment of hemostatic sponge impregnated with one drop of 5% 5-FU; was implanted onto sclerotomy sites and covered with the muscle. The implant was not fixed with sutures, and the conjunctiva was closed with a continuous suture.

Enucleation was performed 14, 30, and 45 days after surgery (8 eyes per point). The specimens were fixed in 2.5% glutaraldehyde in 0.1 M phosphate buffer (pH 7.2) for 12-24 h at 4-5°C, washed with 5% glucose in the same buffer, postfixed with 1% osmic acid (pH 7.2) for 2 h, and dehydrated in ascending concentrations of alcohol. The specimens were then treated with propylene oxide and embedded in Epon-Araldite mixture. Semithin sections (3 μ) were made on an LKB-III microtome and stained with methylene blue—pyronine.

RESULTS

In specimens taken from group 1 rabbits 2 weeks after surgery, the newly formed tissue around the scre-

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rectomy site was loose and thin. There was marked prominence of the uvea and retina through the trepanation hole. The inner membranes were intact, the retina was deformed by intercellular edema in the region of evagination, and the uvea was thinned. The fibers of the collagen sponge moved apart, and the sponge was filled with protein and contained round cells and macrophages (Fig. 1, *a*).

One month after surgery, the perforated zone was filled with fibrovascular tissue. The choroid-retinal complex (enlarged choroidal part, moderately pigmented, with lacunar blood vessels and the retina) protruded into the scleral perforations. The primary fibrovascular tissue was infiltrated with activated sclerocytes from marginal scleral regions, so the tissue adopted a nearly final density at the sites of most intense sclerocyte migration while remaining thinner than the intact sclera. In the outer part of the newly formed tissue, collagen fibers were arranged loosely. The tissue was abundantly vascularized (Fig. 1, *b*). Fragments of the collagen implant were seen in some sections.

In specimens taken 1.5 months after surgery, the newly formed fibrovascular tissue covered scleral defect and acquired the characteristic appearance of the sclera in zone adjacent to undamaged scleral tissue. The loose connective tissue penetrated by enlarged blood vessels remained in the central regions. The lesion at the level of the inner part of the sclera was filled with abnormal choroid tissue enriched with sinusoid-enlarged blood vessels containing blood cells (Fig. 1, *c*). The retinal pigment epithelium slightly protruded into the perforations. The structure of the retina returned to the normal, but remained slightly swollen. The suprachoroidal space at the periphery of perforated holes was enlarged.

In samples taken from group 2 rabbits 2 weeks after surgery, the perforated region was filled with

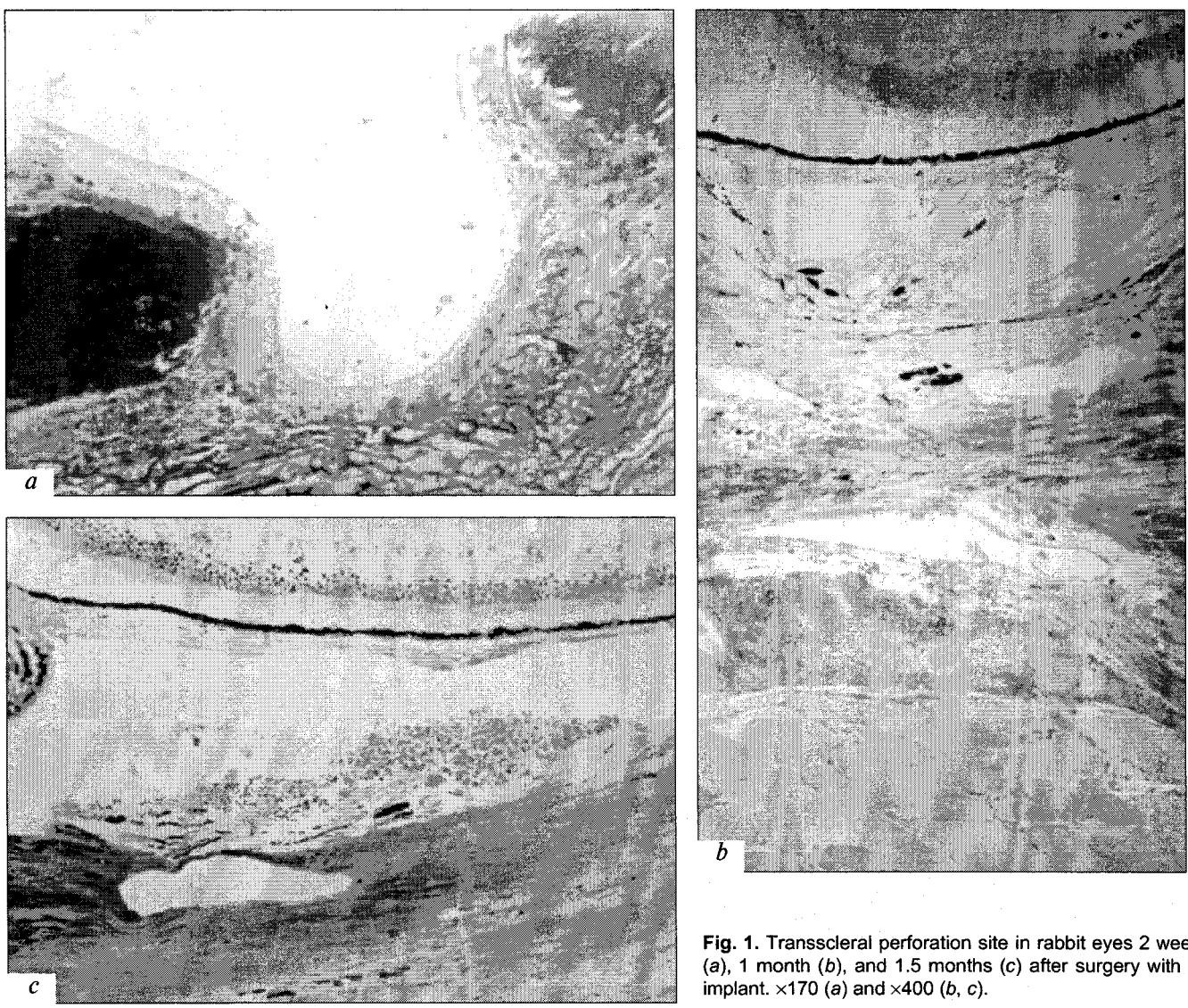

Fig. 1. Transscleral perforation site in rabbit eyes 2 weeks (*a*), 1 month (*b*), and 1.5 months (*c*) after surgery with an implant. ×170 (*a*) and ×400 (*b*, *c*).

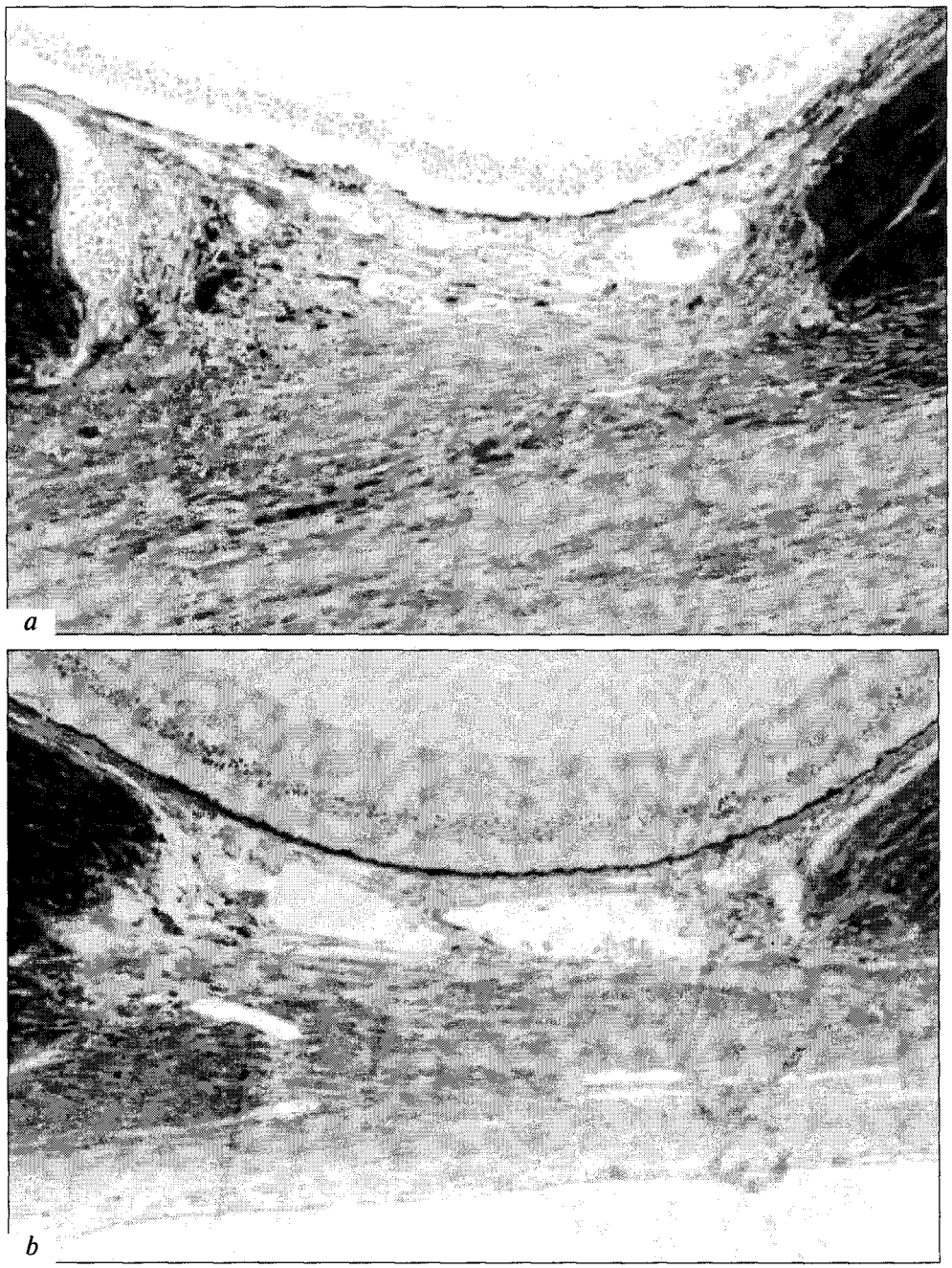

Fig. 2. Transscleral perforation site in rabbit eyes 2 weeks (*a*) and 1 month (*b*) after surgery without an implant. ×400 (*b*).

newly formed connective tissue containing solitary melanocytes and abundant round-cell elements. Inner eye membranes uniformly protruded into the perforated zone, but displayed no signs of damage; the borders of the perforation holes displayed moderate hypertrophy of the retinal pigment epithelium. The outer uveal layer was in tight contact with loose immature connective tissue in the scleral perforations. This zone contained many exchange vessels, some of which were enlarged and contained blood cells (Fig. 2, *a*).

One month after surgery, the perforation holes were filled with mature connective tissue to approximately one half of their depth, but differ from the intact sclera by less compact arrangement of collagen fibers. The choroidal and scleral parts were distinguishable. Abundance of dilated lacunar blood vessels and choroidal melanocytes were characteristic features of the choroidal part, which had a considerable thickness. The scleral part was less vascularized and looked less dese than intact sclera (Fig. 2, *b*).

In this group, the tissue structures displayed no significant dynamics 1.5 months after surgery.

Thus, both surgical procedures resulted in the formation of a transscleral network of exchange blood vessels in the region of scleral perforations, because of which these regions can serve as an additional outflow tract bypassing the main uveal tract. The application of collagen sponge caused pronounced invagination of the uvea and retina and, because of larger area of aseptic inflammation and the formation of blood vessels with large lumens. The alternative vascular system was preserved after both surgical procedures.

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