Direction of Fluid Transport in the Lens

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The direction of fluid flow in rabbits was studied *in vivo* by the distribution of fluorescein in eye structures. Fluorescein was administered into the central part of the lens. Fluorescein migrated from the anterior to posterior surface of the lens and then appeared in the vitreous body. Fluorescein did not migrate to the anterior surface and did not appear in the anterior chamber of the eye.

Key Words: *lens; anterior and posterior surface; direction of flow*

The lens of the eye is situated in the zone of intensive fluid exchange [2] and plays a role in fluid transport. Studies of changes in lens fluid volume allowed to evaluate functional activity of the lens [3]. Previous experiments revealed and characterized ouabain-dependent activity on the anterior surface of the lens [5,6]. These data indicate that the epithelium of the anterior surface of the lens performs transport functions. Fluid transport in the lens should have a specific direction [1]. However, biological microphotographs of fluorescein distribution in the lens did not illustrate vector transfer of fluid flow in the lens. Studying the direction of fluid transport in the lens is of considerable scientific and physiological importance.

This work was designed to study *in vivo* the direction of fluid flow in the lens. *In vivo* biomicroscopy of fluid transport in the lens was performed and fluid distribution in enucleated eyes was evaluated.

MATERIALS AND METHODS

Experiments were performed on 50 eyes of 25 adult male and female rabbits (Sovetskaya Shinshilla) aged 2-3 months and weighing 1.5-2.0 kg. The study satisfied the International Requirements for Experiments on Living Animals. The animals were kept in a vivarium (KrasFarm). The animals were examined before sacrifice and the absence of concomitant diseases was confirmed.

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The direction of fluid flow was estimated by distribution of a marker substance (20% fluorescein) administered into the lens. The solution contained polyvinylpyrrolidone (10 mg per 100 ml) to prevent fluorescein diffusion in the wound channel.

The animals were immobilized before the experiment. A blepharostat was applied to rabbit eye. Anesthesia of the eyes included instillation of 15 ml 1% dicaine and retrobulbar administration of 0.5 ml 2% lidocaine hydrochloride. A viscous solution of fluorescein (0.01 ml) was administered into the central part of the lens. Angle puncture was made with a thin needle introduced through the equator at a distance of 2 mm from the limbus. The direction of fluorescein flow in the mydriatic eyes was estimated *in vivo* by a biomicroscopy with a ShchL-T slit lamp. The animals were killed at 5-30-min intervals after injection of fluorescein. The eyes were enucleated within 1-2 min after death and cooled to -180^{o}C in liquid nitrogen to decrease the degree of diffusion. Transverse sections of the frozen eyes (in relation to the site of dye injection) were obtained on a microtome. The section was photographed with a digital camera.

RESULTS

Fluorescein injected into the lens moved to its posterior surface; 5-7 min after injection fluorescein was found in the retrolental space, then it diffused in the central part of the vitreous body. Forty minutes after injection fluorescein was not visualized in the lens.

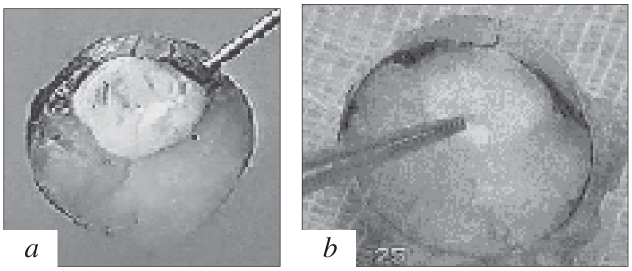

Fig. 1. Distribution of fluorescein in the lens of enucleated eye 5-10 (*a*) and 15-20 min after injection into the lens (*b*).

Fluorescein did not move to the anterior surface of the lens. These data illustrate the existence of fluid flow from the anterior to posterior surface of the lens.

Fluorescein was distributed from the site of injection to the posterior surface of the lens 5-10 min after injection (Fig. 1, *a*). Fluorescein moved from the posterior capsule to the vitreous body 15-20 min after injection (Fig. 1, *b*). We did not reveal an asymmetrical distribution of fluorescein relative to the anterior and posterior surface of the lens. Then, fluorescein was found in both anterior chamber and vitreous body of enucleated eye, probably because inactivation of sodium-potassium pump after death. Under these conditions fluorescein passively diffuses through the capsule of the lens to both directions (towards the anterior chamber and vitreous body).

Our findings show that fluid transport in the anterior capsule of the lens is directed toward the stroma of the lens. The direction of fluid transport in the lens appears as follows: stroma of the lens→posterior capsule of the lens→vitreous body. Transport flow is not directed toward the anterior capsule.

Fluorescein distribution in the lens cannot be explained by diffusion of substances. This process illustrates the existence of directional fluid transport from the anterior to posterior surface, which is formed by the transport system of the lens epithelium.

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