Effects of intraocular perfusion with two alternating irrigation solutions on the simultaneously recorded electroretinogram of albino rabbits

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Abstract. The direct current electroretinogram (DC-ERG) of 15 unilaterally vitrectomized albino rabbits was studied during continuous intraocular irrigation with a recently developed solution ('PHS') produced by Pharmacia Ophthalmics. The mean amplitudes of the b- and c-waves were somewhat lower than corresponding values of previously investigated reference subjects, but not statistically different. In 11 of the 15 rabbits PHS was then replaced by the commonly used balanced salt solution (BSS). The fluids were subsequently repeatedly alternated (PHS, BSS, PHS, BSS, PHS). During irrigation with BSS the average amplitude of the b-wave was reduced to 87% (p < 0.02) and that of the c-wave to 63% (p < 0.001) of the levels obtained during perfusion with PHS. In two rabbits the ERG was studied about one month after vitrectomy, where PHS-irrigation was used both during surgery and for 30 min after its completion. No marked differences were observed between the treated and the untreated eyes as to the b- and c-wave amplitudes at stable stages of the recording. Thus, judged by the ERG, retinal and pigment epithelial functions were influenced unfavorably by BSS, whereas they seemed to be well preserved with PHS. From this point of view PHS appears to be an excellent irrigation solution for vitreoretinal surgery that ought to be clinically tested.

Introduction

Closed intraocular microsurgery is a well established method in the treatment of many vitreoretinal disorders, e.g. longstanding vitreous hemorrhage of different causes, certain cases of proliferative diabetic retinopathy, proliferative vitreoretinopathy, and ocular trauma. During surgery relatively large amounts of intraocular irrigation fluids are used. It is of great importance that the composition of these solutions is adequately balanced in order to avoid injury to the retina, the lens, or in case of aphakia, the cornea. There are several studies concerning the influence of intraocular irrigation solutions on the cornea and on the lens (e.g. Edelhauser et al., 1975, 1976; Christiansen et al., 1976; Weekers and Dethinne, 1978; McEnerney et al., 1978; Graham, 1983), but their effects on the retina have been less extensively investigated. The electroretinogram (ERG) reflects the electric activity of the retinal and pigment epithelial cells in response to a light stimulus, and provides an excellent means of studying retinal physiology in health or disease. In the
present study the ERG was used as a tool to compare the retinal and pigment epithelial effects of two intraocular irrigation fluids: the commonly used, so-called balanced salt solution (BSS), and a recently developed solution (PHS) produced by Pharmacia Ophthalmics. The ERG was recorded during continuous irrigation of the vitrectomized albino rabbit eye alternately with these two fluids, and the responses obtained during each perfusion could thus be compared.

**Material and methods**

**I. Immediate effects**

*Preparation of the animal:* Fifteen albino rabbits were studied. Anesthesia was induced and then maintained with intravenously administered pentobarbital at a stable infusion rate. The pupils were dilated. After the animal was mounted in a head support, the conjunctiva of one eye was incised at the superior part of the limbus. The sclera was opened by a trephine (radius 0.75 mm), the center of which was located about 1 mm behind the insertion of the previously cut superior rectus muscle. A Kaufman Vitrector III system (Concept Inc.), enabling simultaneous fluid infusion and vitrectomy action was used to perform the vitrectomy. During surgery PHS was used for continuous intraocular irrigation. Care was taken to excise the vitreous body as completely as possible in the sector reached with the instrument. Immediately following vitrectomy a concentric double cannula, mounted in a micro-manipulator, was introduced into the eye through the scleral opening. A drop chamber, inserted into the bottle containing the irrigation solution, was connected with the eye by means of a tube system and the inner part of the double cannula. The fluid level of the drop chamber was placed about 30 cm above the eye. After leaving the eye through the enveloping outer part of the double cannula the solution passed to a fluid-filled vessel, the surface of which was located 8 cm above the level of the eye. With this arrangement the theoretical range of intraocular pressure would be 8–30 cm H₂O, corresponding to 6–22 mm Hg.

*Irrigation solutions:* Two irrigation solutions were used: (1) the test solution produced by Pharmacia Ophthalmics (PHS), and (2) balanced salt solution (BSS), manufactured by the pharmacy of the Karolinska Hospital, Stockholm. The composition of the fluids is shown in Table 1. A three-way valve, located about 10 cm from the double cannula, made switching between the two solutions possible. Since the volume of the tube system from the valve to the eye was 1 ml and the infusion rate 50 ml/h, the delay between switching from one solution to the other and its entering the eye was about 1/50 h or 1–1.5 min.

*Electroretinogram recording procedure:* The method of ERG recording,