been shown to be mediated by prostaglandins. Traction and vitrectomy in patients are accompanied by ocular inflammation as measured by protein determination or indomethacin. 3-5 Ocular effects associated with prostaglandins include increased intraocular pressure, miosis, conjunctival hyperemia, and increased anterior chamber protein concentration. 3' 4> G Proteins have been implicated also in inflammation caused by anterior chamber paracentesis, 5-7 cryotherapy, 8 and postchemical trauma. 5 Because cataract extraction and vitrectomy in patients are accompanied by ocular inflammation in the postoperative period, it was the aim of this study to determine whether indomethacin could reduce inflammation after routine lens extraction and vitrectomy-lensectomy.

Material and methods

Lens extraction group. Ten albino rabbits were anesthetized with intravenous pentobarbital sodium. Lens extraction was performed in both eyes of each rabbit according to the following techniques. A limbal incision was made with a No. 15 Bard-Parker blade and enlarged to 180 degrees with corneoscleral scissors. The anterior capsule was ruptured, and the lens expressed through the wound. The incision was closed with running 9-0 nylon sutures, topical ophthalmic ointment (Neosporin) was applied, and the eye taped closed for 1 day.

The rabbits were divided into two groups prior to lens extraction. (1) Five rabbits (10 eyes) underwent lens extraction and received intraperitoneal indomethacin treatment according to the following regimen: 25 mg. three times at 1 day preoperatively; 25 mg. two times on the day of surgery; and 25 mg. two times at 1 day postoperatively. Medication was administered as a 1.25 percent suspension of indomethacin in 0.1M phosphate buffer, pH 8. (2) Five control rabbits (10 eyes) underwent lens extraction; control injection was done with normal saline intraperitoneally following the same schedule as for indomethacin injections.

Rabbits were killed 24 hr. postoperatively. Paracentesis of the aqueous humor was done with a 25-gauge needle through the cornea, withdrawing as much fluid as possible. Protein analyses were done on 0.2 ml. of each sample, which was diluted to 2.0 ml. with 0.9 percent sodium chloride, Trichloroacetic acid, 1.9 ml., was added to each sample. After 5 min. the optical density was read at 420 nm. with a spectrophotometer. Protein concentrations were calculated by comparison with a standard solution.

Vitrectomy-lensectomy group. Eight rabbits (16 eyes) underwent vitrectomy-lensectomy. Of these eight animals, four were treated with indomethacin following the same regimen as described above. Four others received intraperitoneal injections with normal saline and served as controls.

The animals were anesthetized by intravenously given pentobarbital sodium. Mydriasis was accomplished with topically applied 1 percent cyclopentolate hydrochloride and 10 percent phenylephrine hydrochloride. A lateral canthotomy was performed, and traction sutures of 4-0 silk were placed on both lids and the superior and inferior recti. The conjunctiva was dissected away from sclera temporally, and a 2 mm. sclerotomy was done 2 mm. posterior to the limbus with a No. 11 blade. A purse-string suture of 5-0 polyglactin 910 (Vicryl) was placed around the sclerotomy.
site, and diathermy applied to the adjacent sclera. The sclerotomy was deepened through the full thickness of the pars plana. A lens fragmenter was introduced through the incision, the purse-string suture tightened, and the lens pulverized within its capsule. The fragmenter was removed, the wide-angle cutter vitrophage9 introduced, and a lensectomy-vitrectomy performed. Five percent dextrose and 0.45 percent normal saline with 4 -/ug/ml. gentamicin were used as infusion fluid. The purse-string suture was tied following removal of the vitrophage, and the conjunctiva closed with 5-0 polyglactin 910. An ophthalmic ointment (Neo-
sporin) was applied topically, and the eyelids sutured closed for 1 day. Animals were killed 24 hr. postoperatively. Paracentesis and protein analyses were done as for the lens extraction group.

**Results**

**Lens extraction group.** During lens extraction, considerably less exudate was observed in indo-
methacin-treated eyes compared to nontreated control eyes. Postoperatively, less conjunctival hyperemia was noted in indomethacin-treated eyes. Results of protein determinations on aqueous fluid are summarized in Table I. Nine values were used instead of 10 because the amount of fluid obtained in one sample was too small for protein analysis.

Rabbit primary aqueous humor normally contains 20 to 60 mg./100 ml. protein10; hence a dramatic increase in anterior chamber protein concentration was observed postoperatively, even in indo-
methacin-pretreated eyes. The amount of protein in indomethacin-treated eyes, however, was considerably less than that of nontreated controls. The difference between the two groups is quite significant (p <0.001).

**Vitrectomy-lensectomy group.** Indomethacin pretreatment resulted in less postoperative inflam-
mation than in nontreated controls. The protein levels were higher after vitrectomy-lensectomy than after lens extraction. This could be explained by the fact that surgical manipulation was more extensive in the vitrectomy-lensectomy group, and thus more inflammation followed.

This study demonstrates that indomethacin treatment can help reduce ocular inflammation after intraocular surgery and should be considered as a beneficial therapeutic modality.

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firmary, 1855 W. Taylor St., Chicago, Ill. 60612.

**Key words:** indomethacin, lens extraction, vitrec-
tomy, lensectomy, prostaglandins.

**REFERENCES**

1. Neufeld, A. H., Jampol, L. M., and Sears, M. L.: Aspirin prevents the disruption of the

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**Table I. Protein concentration (mg./100 ml.) in aqueous humor after lens extraction**

<table>
<thead>
<tr>
<th>Control</th>
<th>Indomethacin-treated</th>
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</thead>
<tbody>
<tr>
<td>964</td>
<td>382</td>
</tr>
<tr>
<td>374</td>
<td>342</td>
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<tr>
<td>428</td>
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<td>330</td>
</tr>
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<tr>
<td>386</td>
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</tr>
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<td>476</td>
<td>242</td>
</tr>
</tbody>
</table>

Mean 613 ± 14.8

T 20

p <0.001

**Table II. Protein concentration (mg./100 ml.) in ocular fluid after vitrectomy-lensectomy**

<table>
<thead>
<tr>
<th>Control</th>
<th>Indomethacin-treated</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<td>1,000</td>
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<tr>
<td>2,206</td>
<td>1,100</td>
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</tbody>
</table>

Mean 1,450 ± 53

T 8.49

p <0.001

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A superoxide-producing system in the conjunctival mucus thread. Peter Proctor.* Donald Kirkpatrick,† and John McGinness.**

In normal sterile eyes, the conjunctival mucus thread is capable of reducing the vital stain iodonitrotetrazolium (INT). The greatly increased amount of INT reduction in bacterial conjunctivitis has been used as a clinical test for this disorder. We find that native superoxide dismutase, but not the heat inactivated enzyme, inhibits INT reduction by the conjunctival mucus thread and possibly as a mediator of the conjunctival inflammatory response.

The tetrazolium dye, iodonitrotetrazolium (INT) is reduced by acellular vacuoles found in the conjunctival mucus thread of human eyes, forming an insoluble violet precipitate. In bacterial conjunctivitis a marked increase in dye reduction is associated with the infiltration of granulocytes into the mucus thread. The biochemical basis for this test was previously undefined.

The reduction by granulocytes of a similar tetrazolium dye, nitroblue tetrazolium (NBT) provides a clinical test for bacterial infection and for distinguishing between normal granulocytes and granulocytes in chronic granulomatous disease. There is evidence (refs. 2 and 3; however, see ref. 4) that this test reflects (at least partially) the production of the bacteriocidal superoxide anion radical (\(O_2^-\)) by the granulocyte: \(O_2^- + \text{tetrazolium dye} \rightarrow \text{reduced tetrazolium dye (insoluble)} + O_2\).

The clinical and biochemical similarities between vital staining of the conjunctival mucus thread with INT and the measurement of superoxide production with NBT in granulocytes suggested that INT reduction reflects a superoxide-producing system in the mucus thread and possibly in the conjunctiva. We have confirmed this hypothesis using two separate and complementary tests for superoxide production.

Methods

In vivo studies. A 0.01 ml aliquot of a 5 mg/ml solution of superoxide dismutase (SOD) (Miles Laboratories, Kankakee, Ill., 11,500 u/mg) was instilled into the temporal conjunctival sack of the left eye of four New Zealand white male rabbits (5 to 7 lb.). An aliquot of autoclaved SOD was instilled into the right eye. After 7 min, a 0.01 ml aliquot of a 1.0% solution of INT was instilled into both eyes. Two hours later, the mucus threads were removed from both eyes and mounted on glass slides for microscopic viewing.

In vitro studies. To increase the amount of available conjunctival mucus, a mild sterile conjunctivitis was induced by the instillation of drops of ether into the eyes of New Zealand white male rabbits (5 to 7 lb.) previously sedated with 50 mg of chlorpromazine administered intramuscularly. The mucus threads were harvested as they appeared and divided into approximately equal sections (1 to 2 mm wide) on a glass slide. A 0.005 ml aliquot of a 5 mg/ml solution of either native or heat-inactivated SOD in balanced salt solution was instilled onto a section of mucus thread, which was incubated at 25° C for 5 min. in a closed, moisture-saturated Petri dish. A similar section of the same mucus thread was treated with a 0.005 ml of a 3 mg/ml (0.2 mM) solution of 3,4-dihydroxybenzoic acid (DHBA). At the end of the incubation time, 0.005 ml of INT (1% in water) was instilled onto the mucus threads which were returned to the Petri dish for 30 min. incubation at 25° C. The reaction was stopped by washing with 50% ethanol/water, The