cate that, depending on the concentration, acetylcholine may in fact cause vasodilation as well as vasoconstriction.\textsuperscript{10}

The changes in blood flow of the ciliary body during stimulation were puzzling. In the ciliary body of the monkey the blood flow increased during oculomotor nerve stimulation, but the increase could not be blocked by atropine, which makes the cholinergic nature of the response doubtful. In the cat the blood flow of the ciliary body also increased during stimulation, and this increase could be blocked by atropine. Whether the increase was secondary to muscle contraction and release of metabolites or primarily an effect on the blood vessels is not clear. The blood flow of the ciliary processes in the rabbit decreased during stimulation were uniform in the cats and monkeys. The changes in blood flow of the ciliary body and choroid were also supported by a grant from the Finnish Academy of Sciences and a grant (5ROI EY00475-11) from the National Eye Institute, U. S. Public Health Service. The investigation was supported by a grant from the Swedish Medical Research Council and a grant from the Finnish Academy of Sciences and a grant from the Swedish Medical Research Council and a grant from the Finnish Academy of Sciences and Finska Lakaresiillskapet to J. S.

From the Institute of Physiology and Medical Biophysics, Biomedical Centre, University of Uppsala, Sweden. This investigation was supported by a grant from the Finnish Academy of Sciences and a grant from the Finnish Academy of Sciences and Finska Lakaresiillskapet to J. S.

Key words: oculomotor nerve stimulation, ocular blood flow, monkey, cat, rabbit

REFERENCES


A method of iodine vapor cautery was applied to rabbit eyes. The cautery produces an approximately circular area denuded of epithelium of uniform size. The eye is not inflamed, and the very rapid mean healing rate of 1.42 mm\textsuperscript{2} hr\textsuperscript{-1} was observed.

In this paper we present a simple method of producing reasonably uniform iodine vapor burns of rabbit corneas and basic statistics of their healing.

Methods and materials. In 1952 Grant\textsuperscript{1} described a method for treating herpes simplex of the cornea with iodine vapor. Iodine crystals are held in a glass tube by a plug of glass wool. The face of the packed crystals is about 2 cm from the mouth of the tube. When not in use, the tube is closed by a glass thimble (Fig. 1). To produce a lesion, the tube is uncapped, and the mouth of the tube is held against the cornea of the proposed eye of the anesthetized rabbit for a period of time. Our tube has an inside diameter of 7.4 mm and an
outside diameter of 11.0 mm at the lip. We found the application time of 3.5 min suggested by Grant quite satisfactory. No cocaine or other neutralization is used. In 3 to 4 hr, the epithelium exposed to iodine vapor sloughs away, revealing an approximately circular denuded patch (Fig. 2). In our experiments, the rabbits were anesthetized with pentobarbital, either 30 mg/kg intravenously or 60 mg/kg intraperitoneally. Two drops of 0.5% proparacaine were then instilled in the eye, the eye was propstosed; the lip of the iodine tube was wiped on filter paper and then pressed against the cornea as centrally as possible for 3.5 min. Both eyes of each animal were treated, right eye first.

Recording of the lesions was by photography. The cornea was stained with 1 drop of 2% fluorescein and flushed with 2 drops of water. The lesion was photographed on Kodak Tri-X Pan film with a fixed-focus camera. A Wratten 47B filter covered the electronic flash, and a Wratten 12 filter was placed over the camera lens. The rabbit's cheek was held against a stop placed at the camera focus.

Fig. 1. Iodine vapor applicator.

Fig. 2. Typical corneal iodine vapor burn healing course in the two eyes of rabbit 21. Hours after iodine vapor cautery: from top down, 17.5, 26.0, 45.5. The lesions remain nearly circular and equal in size throughout healing.
Tables IA to IC. Area of denuded cornea following iodine vapor cautery Table IA. Rabbits 15 to 18*

<table>
<thead>
<tr>
<th>Time after burn (hr)</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE</td>
<td>LE</td>
<td>RE</td>
<td>LE</td>
</tr>
<tr>
<td>3.5</td>
<td>64.7</td>
<td>81.2</td>
<td>80.5</td>
<td>70.4</td>
</tr>
<tr>
<td>18.2</td>
<td>44.4</td>
<td>55.9</td>
<td>41.7</td>
<td>57.8</td>
</tr>
<tr>
<td>21.8</td>
<td>26.9</td>
<td>45.4</td>
<td>39.6</td>
<td>49.5</td>
</tr>
<tr>
<td>25.5</td>
<td>35.0</td>
<td>38.9</td>
<td>47.3</td>
<td>34.9</td>
</tr>
<tr>
<td>32.0</td>
<td>14.6</td>
<td>22.9</td>
<td>25.4</td>
<td>25.7</td>
</tr>
<tr>
<td>41.5</td>
<td>2.1</td>
<td>6.6</td>
<td>9.5</td>
<td>11.9</td>
</tr>
<tr>
<td>45.1</td>
<td>1</td>
<td>1.5</td>
<td>5.0</td>
<td>6.5</td>
</tr>
<tr>
<td>49.1</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
<td>3.2</td>
</tr>
<tr>
<td>55.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>66.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No. 1</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>$a_0$</td>
<td>71.02</td>
<td>88.86</td>
<td>81.12</td>
<td>79.92</td>
</tr>
<tr>
<td>$a_1$</td>
<td>-1.67</td>
<td>-1.97</td>
<td>-1.68</td>
<td>-1.60</td>
</tr>
</tbody>
</table>

$r$ (R vs. L) | 0.98 | 0.94 | 0.97 | 0.99

*Data for each eye was fit by the method of least squares to a line of the form $y = a_0 + a_1x$ in which $y = area of burn (\text{mm}^2)$, $x = time since burn (\text{hr})$, $a_0 = area at zero time (\text{mm}^2)$, and $a_1 = healing rate (\text{mm/hr})$. Also each pair of eyes was compared for correlation of healing behavior by the formula:

$$r = \frac{s_{RBL}}{s_{RL} s_{LR}}$$

in which $r = correlation coefficient of right and left eyes, s_{R} = standard deviation, right eye, and s_{L} = standard deviation, left eye.

1No. of observations.

The film was developed in HC 110 (1 part developer plus 3 parts water) for 4½ min at 68° F. The negatives were projected on a ground-glass screen at about eight times linear magnification. A piece of millimeter graph paper was photographed at the beginning of each film. Since the lesions remained approximately circular throughout healing (Fig. 2), the diameter was measured with a vernier caliper held against the screen on the side away from the projector. If the lesion appeared to be elliptical, the diameter at about 45° to the axis of the ellipse was employed. In case of other irregularities of the lesion, a visual estimate of the mean diameter was used. Lesion size was corrected for magnification, and the approximate lesion area was computed. The method is thus subject to several approximations: the circle approximation just mentioned; the assumption that all photographs were taken at the same distance and hence have a standard object size : image size ratio; and that the lesion plane was at right angles to the camera lens axis. Repeat photographs and caliper measurements of the millimeter-scale projection gave a standard deviation of 0.23 mm and standard error of the mean of 0.09 mm actual size. The camera was foot-operated by a bulb placed on the floor so that the operator had both hands free to position the rabbit.

Iodine vapor cautery was applied to each eye of eight albino rabbits (2 to 2.5 kg), and the course of healing was recorded. Observations and photographs were made every 4 to 6 hr between 8 A.M. and 10 P.M. The rabbits were treated in three groups: rabbits 15 to 18 (Table IA), 19 and 20.
Results. As was expected, the healing of the two eyes of one rabbit showed a very good correlation (all \( r = 0.93 \)) but there was more variation in healing from rabbit to rabbit (Tables IA to IC).

There was occasional breakdown of the healed epithelial lesion, followed by delayed re-healing. If all the observations (omitting breakdowns and secondary healing) are lumped and a line fitted by the least-squares method, its equation is Area of lesion (\( \text{mm}^2 \)) = 69.74 \( \text{mm}^2 \) + 1.42 \( \text{mm}^2/\text{hr} \) times hours since burn \( (r^2 = 0.76) \).

Of interest is the minimal and very transient conjunctival inflammation that occurred. The conjunctiva became "white" a few hours after the initial insult and remained white. After about 12 hr, the rabbits kept their eyes open; the eyes were not purulent and to casual inspection were normal.

Discussion. The experiments described herein reiterate the fact that the two eyes of one rabbit respond to a standard lesion more alike than do the eyes of different rabbits.

The possibility of producing very similar lesions in the two eyes has been demonstrated and recalls the work of Buehler and Newmann, who used a suction cup to confine liquid irritants, and of Holtmann et al., who used a plastic mask and alcohol to denude a standard area of cornea.

The mean healing rate in the present experiment (1.42 \( \text{mm}^2/\text{hr} \)) is faster than the fastest rate recorded, 1.0 \( \text{mm}^2/\text{hr} \), estimated from the work of Thoft and Friend and is considerably faster than other estimates. It may be that the avoidance of mechanical injury to the basement membrane by the present procedure permitted more prompt healing.

From the Department of Ophthalmology and the Oscar Johnson Institute, Washington University School of Medicine, St. Louis, Mo. This work was supported in part by NEI Grant 5 RO1 EY 00256, from the National Institutes of Health, Bethesda, Maryland. Submitted May 30, 1978. Reprint requests: Robert A. Moses, M.D., Department of Ophthalmology, Washington University School of Medicine, 660 S. Euclid, St. Louis, Mo. 63110.

Key words: corneal epithelium, corneal wound healing, standard lesion

REFERENCES