Full-thickness eye wall resection: 
Evaluation of preoperative photocoagulation

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An improved technique for resecting a portion of the posterior segment is described. Preoperative photocoagulation and diathermy at the time of surgery provided adequate hemostasis and prevented postoperative retinal detachment. The use of Castroviejo trephine as the cutting instrument permitted histologic examination of the resected tissue.

Key words: Photocoagulation, diathermy, full-thickness eye wall resection, "eye basket," Castroviejo trephine, choroidal melanomas.

Choroidal tumors still pose many problems for the ophthalmologist in terms of diagnosis and treatment. Present diagnostic methods, including ophthalmoscopy, fluorescein angiography,1 2 transillumination,3 4 ultrasonography,3 5 and examination of subretinal fluid,3 6 do not always reveal the nature of the tumor, resulting in unnecessary enucleations in a small percentage of cases.10 13 Conservative treatment measures, such as photocoagulation,14 16 diathermy,17 18 or radiotherapy,19 23 have not been effective in treating tumors greater than 7.5 mm base diameter15 18 19 and are not widely accepted.

Our previous work has shown that holoresection of the eye wall in animals is possible and that homograft sclera can be used to replace the resected tissue.1 1 17 19 In the preliminary studies, a Bovie electrosurgical cutting unit was used to excise a portion of the posterior segment. However, the coagulating action of the Bovie unit rendered the surgical specimen unfit for histologic examination.

In this experiment an attempt is made to alter the procedure so that the resected tissue might be saved for microscopic diagnosis. Photocoagulation, diathermy, and full-thickness eye wall resection with a Castroviejo trephine are evaluated as adjuncts to the previously reported procedure.

Materials and methods

Ten pigmented and 5 albino rabbits weighing 4 to 5 pounds each were used in this series of
Full-thickness eye wall resection

Fig. 1. Fundus photograph. Arrows indicate double row of photocoagulation scar prior to resection.

Fig. 2. Eye basket: A. Ring, which is placed over area to be resected; B. Pliable side arms; C. Handle.

Fig. 3. The eye basket is sutured in place. Diathermy is applied around area to be resected.

Fig. 4. The trephine is in position to resect circular portion of eye wall.

Fig. 5. Diathermy is reapplied to achieve hemostasis at wound edge.

Fig. 6. Scleral graft sutured to surrounding host sclera.

Fig. 7. Needle cannula inserted beneath graft edge to reestablish intraocular pressure.

experiments. Three weeks prior to resection, the animals were anesthetized with intravenous sodium pentobarbital and were given 0.12 mg. atropine sulfate intramuscularly to control secretions. The eyes were dilated with 1 per cent cyclopentolate. Using a West German Zeiss Xenon arc photoocoagulator, set at energy level Green I with a field diaphragm of 6° and an iris diaphragm of 0 to 3, a double circular row of applications was made surrounding an area 5 to 7 disc diameters in the temporal area of the fundus in the right eye.

Three weeks following the photocoagulation, when a chorioretinal scar was present (Fig. 1), the animals were once more anesthetized and their pupils dilated by the above method. A temporal canthotomy was made and the conjunctiva dissected away to expose the globe. The photocoagulation scar was delineated by transillumination through the eye. The "eye basket," 12 mm. in diameter and (Fig. 2) described in a previous publication, was placed around the photocoagulation scar, 9 to 11 mm. in diameter, on the temporal area of the globe. After the side arms of the "eye basket" were passed beneath the superior and inferior rectus muscles, the "eye basket" was sutured to the episclera with 8-0 silk. Diathermy applications were made in a circle, 7 to 8 mm. in diameter, immediately surrounding the area to be removed (Fig. 3).

The actual resection was accomplished with a 7 mm. Castroviejo trephine (Fig. 4). The resected portion of the eye wall was immediately placed in a fixative solution, described below, for histologic study.

Any areas of hemorrhage at the wound edge were retreated with diathermy until the bleeding was controlled (Fig. 5).

A scleral homograft, 7.5 mm. in diameter, previously prepared from rabbit tissue stored in liquid nitrogen was sutured over the hiatus in the eyeball with 7-0 chromic gut sewn in a continuous running stitch (Fig. 6). To reestablish intraocular pressure, the tip of a 30 gauge cannula attached to a 3 c.c. syringe was inserted beneath the homograft and a saline solution containing gentamicin, 200 mcg. per cubic centimeter, was injected into the vitreous cavity (Fig. 7). Once the intraocular pressure was restored, the cannula was withdrawn and the "eye basket"
Fig. 8. Fundus photograph three months after resection. Single arrows indicate graft edge. Double arrows indicate chorioretinal scar.

Fig. 9. Histologic section of eye after holoresection. Arrows indicate edges of the resection.

Fig. 10. Magnification of the transitional zone between host sclera and graft. Arrow shows chorioretinal scar formation at the edge of the graft.

Fig. 11. Histologic section of resected portion of host eye wall.

Minimal bleeding in all cases occurred at the time of resection. Hemostasis was easily achieved in all animals with the use of diathermy.

Immediately after operation, the fundus and graft were clearly visible. At the edge of the graft a small amount of blood was universally present. Postoperatively, all eyes exhibited a slight iritis manifested by a minimal Tyndall phenomenon in the anterior chamber which lasted for an average of 7 days. The anterior segment reaction

was removed from the eye. The conjunctiva and canthotomy were repaired with 5-0 chromic gut. Immediate postoperative fundus photographs were taken and neosporin ophthalmic ointment was applied topically.

The eyes were cleaned daily with saline and topical antibiotics were given for 7 days. Fundus photographs were taken at intervals during the postoperative period. Intraocular pressures were tested 2 months after operation by applamatic tonometer (Bausch & Lomb, Rochester, N. Y.). Electoretinograms were recorded on selected rab-

bits 1 month after surgery. Three months following operation, the animals were killed and the eyes enucleated for histologic study. All eyes were placed in a 1:1 formaldehyde-glutaraldehyde solution in a phosphate buffer of pH 7.4. The eyes were dehydrated in alcohol and embedded in paraffin. Sections were cut on an American Optical microtome and stained with hematoxylin and eosin and examined under a light microscope.
left no permanent sequelae and was significantly less than in previous experiments. The vitreous remained clear and the blood at the edge of the resection was reabsorbed in 2 to 3 weeks.

One month after surgery, all eyes appeared externally normal. On ophthalmoscopy, the graft could be easily seen as a white area in the temporal fundus surrounded by chorioretinal scarring secondary to photocoagulation and diathermy (Fig. 8). The remaining areas of retina and choroid revealed no abnormality. The vitreous maintained transparency. All eyes remained normotensive with pressures ranging between 11 and 15 mm Hg. Electroretinograms showed a decline in the voltage of the photopic response in the operated eye.

Histologically, all retinas were in place (Fig. 9) and chorioretinal scar formation encircled the homograft (Fig. 10). There was little inflammatory cell response at the junction of normal eye wall and scleral transplant. The resected portion of eye wall revealed all 3 layers of the eye were excised (Fig. 11).

Discussion

Several modifications to the surgical procedure for full-thickness eye wall resection have been presented which seem to provide significant advantages over the earlier techniques.

In previous studies, the coagulating action of the Bovie cautery encouraged chorioretinal scar formation in the postoperative period in an attempt to prevent retinal detachment. In this study, the cicatrization achieved with the use of preoperative photocoagulation with a Xenon arc provided advance protection against retinal detachment following resection. In addition, photocoagulation occluded the majority of choroidal and retinal blood vessels and significantly reduced the amount of bleeding during the operation. The use of diathermy immediately before and after the eye wall was trephined closed the remaining patent choroidal vessels, thus reinforcing protection against hemorrhage at the site of incision.

The use of a trephine as the cutting instrument presents another improvement. The trephine produced a surgical specimen suitable for histologic examination, which was not possible with the Bovie electrosurgical cutting unit. Immediate frozen section of this material would be invaluable to the ophthalmologist for diagnosis of the tumor in question. The surgeon could also determine if the tumor had been completely removed.

Re-establishment of intraocular pressure through a cannula inserted at the wound edge instead of through the cornea, as was done in previous experiments, was a simple alteration in the procedure which proved satisfactory and eliminated unnecessary trauma to the anterior segment. The addition of gentamicin to the vitreal replacement fluid provided prophylactic protection against endophthalmitis.

The lack of permanent damage to the resected eyes is highly encouraging. The maintenance of normal intraocular tension shows that there was no significant leakage around the site of the graft. The reduction of voltage in the photopic response in the ERG is probably due to the sizable number of electrically active neurons in the retina that were removed during surgery.

In conclusion, this study was a continuation of previous efforts at eye wall resection. Preoperative photocoagulation and diathermy just prior to resection made trephination of the eye wall feasible by eliminating significant intraoperative hemorrhage. The use of a trephine permits histologic examination of the resected specimen.

REFERENCES