Lens-sparing Vitreous Surgery for Tractional Stage 4A Retinopathy of Prematurity Retinal Detachments

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Purpose: To assess the efficacy of lens-sparing vitrectomy in tractional 4A retinopathy of prematurity (ROP) retinal detachments in reducing progression to stage 4B or 5 ROP.

Design: Retrospective, noncomparative consecutive case series.

Participants: Forty eyes (31 patients) with stage 4A ROP at 38 to 42 weeks post-conceptional age.

Intervention: Lens-sparing vitrectomy.

Main Outcome Measures: Retinal attachment status and presence/absence of fixation behavior.

Results: The range of follow-up was 6 to 22 months (mean, 12 months). Ninety percent (36 of 40) of eyes showed retinal reattachment and fixation behavior at their last follow-up visit.

Conclusions: These results suggest that vitreous surgery can interrupt progression of ROP from stage 4A to stages 4B or 5. *Ophthalmology 2001;108:2068–2070 © 2001 by the American Academy of Ophthalmology.*

Several authors have reported success in reattaching the retina in eyes with stage 4B or stage 5 retinopathy of prematurity (ROP) related retinal detachment, yet visual outcome is rarely better than 20/400.[1–4] Although scleral buckling for stage 4B and 5 ROP may provide an anatomic outcome superior to the natural history of the disease, this approach does not provide visual results as rewarding as one would hope because of induced anisometropia and amblyopia. Nor does scleral buckling deal directly with vitreous traction.

For these reasons, we undertook an analysis of children who had progressed to stage 4A ROP. We sought to interrupt the pathogenetic cycle leading to stage 4B and 5 ROP by earlier intervention with vitreous surgery, because detachment of the fovea has a devastating effect on visual acuity. These eyes underwent lens-sparing vitreous surgery[5,6] at 38 to 42 weeks postmenstrual age, at a time when it is likely that the ROP-related traction retinal detachment was still evolving.[7]

Material and Methods

This noncomparative consecutive case series included 40 eyes of 31 patients with a minimum of 6 months follow-up. All eyes had stage 4A tractional ROP. All eyes had undergone laser peripheral ablation for vascularly active stage 3 ROP.

All children underwent two-port lens-sparing vitrectomy at 38 to 42 weeks postmenstrual age after obtaining parental informed consent. Because of concern relative to the intraocular risk of vitreous surgery, the first 14 children operated on were originally referred for stage 4B or 5 ROP-related traction retinal detachment in the fellow eye. Before surgery on the more involved eye (stage 4B or 5, macula off), the eye with a less advanced traction retinal detachment (stage 4A, macula-on, involving at least 8 clock-hours) underwent vitrectomy. This intervention was performed in an attempt to interrupt the pathogenetic cycle leading to more complex retinal detachment, because ROP progresses at a similar rate in both eyes in approximately 85% of premature infants.[8] In addition, eyes detached at this age are perhaps more likely to progress than eyes detached 3 months after term, as demonstrated in the CRYO-ROP Study.[8] After these initial 14 fellow eyes, the remaining 26 eyes underwent vitrectomy for stage 4A ROP with six or more clock hours of retinal detachment, independent of the status of the other eye. Eight children had unilateral 4A retinal detachments, and nine children had bilateral 4A retinal detachments. In all, vitrectomy was performed in 40 eyes of 31 infants.

The children were followed for 6 to 22 months (average follow-up, 12 months). Retinal position and presence or absence of fixation behavior were recorded at their last clinical examination.

Surgical Method

The surgical technique, using an infusion light pipe, vitreous cutter, and membrane peeler cutter (MPC) scissors, has been previously described.[5,6] The eye is entered through the pars plicata at a clock hour advantageous to approaching the existing traction. Core vitrectomy is performed addressing the organized vitreous in four planes: transvitreal ridge-to-ridge, ridge-to-periphery, ridge-to-lens, and tentacles from the central stalk of organized vitreous extending from the optic nerve head to the ridge. When this dissection is complete, a fluid–air exchange are performed. The sclerotomies were closed, and the child positioned such that the air bubble would encourage the retina to be reattached, displacing subretinal fluid. All of the eyes that underwent vitreous surgery for 4A ROP were vascularly quiet at the time of vitreous surgery as

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assessed at examination under anesthesia immediately before vitreous surgery.

Results

Thirteen of the infants were female and 18 male. Birth weights ranged from 450 to 1100 g, with an average birth weight of 820 g. The children's gestational ages at birth ranged from 23 to 29 weeks, with an average gestational age of 26 weeks. Age range at the time of surgery was 38–42 weeks.

At the last follow-up examination, 36 of 40 eyes showed complete retinal reattachment and central steady and maintained fixation.

No other forms of vision testing other than clinical observation are available at this time. Four eyes progressed to 4B retinal detachments, and in three of those four eyes the retinas were reattached after repeat vitreous surgery. One eye progressed to stage 5 ROP.

No eyes had endophthalmitis or rhegmatogenous retinal detachment develop. Two eyes with retinal reattachment were found to have glaucoma with edematous corneas and tearing. Both were managed with ocular hypotensive medication.

Discussion

Advances in screening and peripheral ablation have made it possible to identify children with vascularly quiet eyes and tractional 4A retinal detachments of ROP. Improved instrumentation for vitreous surgery in infants (infusion light pipes allowing a two-port technique, wide-angle viewing systems, smaller mechanized scissors) have made it possible to perform lens-sparing vitrectomy earlier in the course of the evolution of ROP-related retinal detachment. Relief of vitreous traction can interrupt the evolution of retinal detachment, which begins in the area of the ROP ridge and tends to extend circumferentially, as well as anteroposteriorly from that ridge.

The potential benefits of vitrectomy in infants with stage 4A ROP should be considered in light of the potential complications of this procedure. The most important complications of vitreous surgery are endophthalmitis, rhegmatogenous retinal detachment, and development of cataract. Although endophthalmitis is potentially devastating, it is rare after vitreous surgery, seen once in several thousand cases. The incidence of rhegmatogenous retinal detachment in eyes of infants undergoing lens-sparing vitrectomy for 4A ROP is likely lower than the ~1% occurrence reported in adults because of the extensive peripheral retinopexy, which has been performed on virtually all infant eyes. Cataract, a common complication of vitreous surgery in adults, is seen in only 15% of children.[9]

The potential benefit of vitrectomy in these eyes should also be evaluated in light of both the untreated natural history of 4A retinal detachments and outcomes after conventional management of such detachments using scleral buckle. Gilbert et al[7] reported on the long-term structural and functional outcome of eyes with partial retinal detachment in the Multicenter Trial of Cryotherapy for Retinopathy of Prematurity. The retina was divided into 34 segments: one segment per each of the 12 clock-hours in zones 1 and 2, and one segment for each of the 10 clock-hours in zone 3. Eyes were followed from 3 months to 4.5 years after diagnosis of threshold ROP. An unfavorable outcome occurred in 92% of eyes with 13 or more segments of retinal detachment, none of which achieved a visual acuity of better than 20/200. Although the number of eyes was small, 50% (four of eight) of eyes with one to three segments had vision of light perception or worse. Most eyes with partial retinal detachment had poor visual acuity or were blind at 4.5 years, irrespective of whether the fovea was involved. Additional natural history data are provided by experience with eyes of adults with ROP. Such eyes often require cataract surgery at a relatively early age. Vitreoretinal adhesions to the lens place these eyes at risk for retinal tear and detachment after cataract surgery.[10]

There are numerous advantages to lens-sparing vitrectomy over scleral buckle for tractional stage 4A ROP retinal detachments. First, scleral buckle has an anatomic success rate on the order of only 70%.[3,11] Second, placement of a scleral buckle requires an additional procedure to divide the encircling element so that the eye may continue to grow. Third, Chow et al[12] reported that scleral buckling could produce an induced mean anisometropia of −9.5 diopters, with residual myopia on the order of −5 diopters, even after the encircling element is divided. Fourth, visual acuity results for stage 4A detachments repaired with scleral buckling surgery techniques have been very discouraging. Although visual acuities have not yet been measured accurately in children with lens-sparing vitrectomy, the potential for very good visual acuity should be high based on the central, steady, and maintained fixation behavior noted to date.

The timing of vitreous surgical intervention on eyes with stage 4A ROP is an important consideration, just as stage 3 ROP requires rapid intervention when conventional threshold is reached. Gilbert et al[7] noted that in the setting of stage 4A ROP, the best chance for an interruption of the pathogenetic mechanism leading to stage 4B or 5 ROP occurs when the stage 4A detachment does not progress beyond three segments. Absolute prevention of any retinal detachment should be the goal in eyes with ROP. In practical terms, the ideal timing for vitreoretinal intervention is when the vascular activity (dilation and tortuosity) has abated and detachment just begun. This customarily occurs sometime around the child's due date.

A limitation of the current series is that it is neither randomized, nor prospective, nor controlled. Similar series of eyes with stage 4A ROP managed with scleral buckle seem to fare better than the untreated natural history of this condition. The 90% anatomic success rate of lens-sparing vitrectomy for 4A ROP reported in the current series is far superior with regard to both anatomic outcome and visual prognosis. Our data suggest lens-sparing vitrectomy for 4A ROP may reduce the progression to stage 4B and 5, with the potential for significant positive impact on visual outcome.

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