Modified 23-Gauge Vitrectomy System for Stage 4 Retinopathy of Prematurity

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**Objective:** To evaluate the outcome of a novel, modified 23-gauge vitrectomy system in the treatment of stage 4 retinal detachment in retinopathy of prematurity.

**Methods:** Consecutive patients with stage 4 retinopathy of prematurity treated with modified 23-gauge vitrectomy were included in this medical record review. Major novel modifications included the use of a small infusion cannula, a 20-gauge blade for the creation of sclerotomies in the pars plicata, and a 23-gauge endoilluminator and vitreous cutter. Conjunctival dissection and suturing of sclerotomies were performed using this modified 3-port, 23-gauge vitrectomy technique. Anatomic success and surgical complications were analyzed.

**Results:** Twenty-six eyes of 17 patients were included and analyzed. The mean (SD) gestational age was 28.0 (2.5) weeks, and the mean birth weight was 1199 (449) g. Mean postmenstrual age at the time of vitrectomy was 40.5 (3.0) weeks. Overall, 20 eyes (77%) achieved retinal attachment in a single operation, and 23 eyes (88%) achieved retinal attachment after multiple procedures. Postoperative complications included disc dragging (5 eyes [19%]), cataracts (4 [15%]), glaucoma (2 [8%]), persistent vitreous hemorrhage (1 [4%]), and posterior synechiae (1 [4%]).

**Conclusions:** This 23-gauge vitrectomy system seems to be a safe and effective approach for treatment of stage 4 retinopathy of prematurity. This modified system combines the benefits of 20- and 23-gauge vitrectomy and offers safer insertion of infusion cannulas in smaller eyes, more working space in pediatric eyes, a cutting port that is closer to the retina, and a faster cutting speed with less vitreous traction during the operation.

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gauge vitrectomy is carried out for stage 4 and 5 ROP. In this report, we describe our modified 23-gauge approach for treatment of stage 4 ROP. This is a single-surgeon, consecutive case series performed over several years. To our knowledge, this is the first report of this approach for retinal detachment associated with ROP.

METHODS

DATA COLLECTION

This study was performed using consecutive medical record review. Written informed consent had been obtained from the parents or legal guardians of the infants before intervention. The study was approved by the institutional review board of Chang Gung Memorial Hospital, Taoyuan, Taiwan. The records of patients with stage 4A or 4B ROP who underwent the modified 23-gauge vitrectomy technique between June 1, 2007, and May 31, 2010, were included. The following information was collected from the medical records: sex, gestational age, birth weight, laterality, previous treatments, postmenstrual age at the time of surgical intervention, intraoperative complications, anatomic success, and postoperative complications. The records of patients with a follow-up time of less than 6 months were excluded.

SURGICAL TECHNIQUE

When the plus disease or pre-plus disease was eminent or there was extensive proliferation of fibrovascular membranes in the ROP eyes, bevacizumab (Avastin) was administered intravitreally less than a week before vitrectomy. Injection of bevacizumab was used primarily to reduce the chances of bleeding during the subsequent vitrectomy. Three-port pars plicata vitrectomy using 23-gauge instrumentation was performed by one of us (W.-C.W.). The pupil was dilated with phenylephrine, 1.25% (Wu Fu Laboratories Co Ltd, Yilan, Taiwan), and tropicamide, 1% (Mydriacyl; Alcon-Couvreur, Puurs, Belgium), before vitrectomy. Conjunctival dissection was performed to expose the pars plicata. The sclerotomy was made approximately 0.5 to 1.0 mm posterior to the limbus through the pars plicata with a 20-gauge microvitreoretinal (MVR) blade. Trocar cannulas were not used. The MVR was directed perpendicularly to the globe initially and then directed toward the center of the eyeball after the MVR blade passed the lens equator. The infusion was placed at the sclerotomy in the inferotemporal or inferonasal quadrant by an anterior chamber maintainer with a self-retaining anterior chamber maintainer 20 gauge; PMS, Tuttlingen, Germany) (Figure 1) depending on the configuration and extent of retinal detachment. The position of the infusion tip was confirmed with an endoilluminator before initiating the infusion. The remaining 2 sclerotomies were made at approximately the 3-o’clock and 9-o’clock positions so that both the superior and inferior vitreous could be addressed with a vitreous cutter without damaging the lens (Figure 2). The 23-gauge vitreous cutting tool and endoilluminator were then inserted through the remaining 2 sclerotomies in the horizontal region. The vitrectomy machine (Accurus; Alcon, Fort Worth, Texas) was used with vacuum levels of 150 to 250 mm Hg and cutting rates of 1200 to 1500 cuts per minute. The traditional proportional vacuum mode was used. A wide-angle viewing system (Volk Optical Inc, Mentor, Ohio) was used to view the peripheral retina. A corneal contact lens was used for central retina viewing. The surgical goal was to relieve vitreous traction on the retina to the greatest extent possible. Traction forces from the ridge to peripheral retinal walls, ridge to lens, ridge to ridge, and ridge to the optic disc were addressed (Figure 3). Care was taken to avoid a retinal break or hemorrhage during the procedure. The lens was not removed unless the proximity of the retina to the lens greatly limited the space available at the surgical entry site. Partial gas-fluid exchange was performed at the end of the operation to prevent ocular hypotony during suturing of the sclerotomy. The conjunctival wound was then closed with an 8-0 polyglactin 910 suture (Vicryl; Ethicon, Inc, Somerville, New Jersey). At the end of the operation, a transparent plastic eye shield was used to reduce the chance of eye rubbing or direct trauma by hands.

RESULTS

Twenty-one patients underwent modified 23-gauge vitrectomy between June 1, 2007, and May 31, 2010. The records of 4 patients were excluded because of follow-up of less than 6 months. Therefore, data on 26 eyes from 17 patients (10 boys and 7 girls) were included and
analyzed in this study. The mean gestational age was 28.0
(2.5) weeks (range, 24-31 weeks), and the mean birth
weight was 1199(449) g (range, 556-2400 g). The mean
follow-up time of the patients was 13.9 (9.5) months
(range, 6-34 months). The patient characteristics and sur-
gical results are shown in the Table.

Fifteen eyes of 9 patients were stage 4A ROP, and 11
eyes of 8 patients were stage 4B ROP. Twenty-three of
26 eyes (88%) were subjected to laser treatment before
vitrectomy. The mean number of laser treatments was
1.5(0.5) (range, 1-2). Eight eyes (31%) received a beva-
cizumab injection before vitrectomy. Scleral buckling had
been performed in 4 eyes (15%) at other hospitals be-
fore they received vitrectomy at our hospital. In these eyes,
scleral buckle was dissected at the time of vitrectomy.
Combined vitreous or preretinal hemorrhage was found
in 5 eyes (19%) with stage 4 ROP. One stage 4B eye was
found to have combined tractional and rhegmatog-
enous retinal detachment. For the other eyes, the reti-
nal detachment was only tractional. Mean postmen-
stral age at the time of vitrectomy was 40.5(3.0) weeks
(range, 36-50 weeks). Final retinal reattachment was
achieved in 23 eyes (88%). Two eyes (8%) with stage 4A
ROP progressed to stage 4B ROP after initial 23-gauge
vitrectomy and received additional vitrectomies to reat-
tach the retina. One eye (4%) with stage 4A ROP pro-
gressed to stage 5 ROP, and successful retinal reattach-
ment was achieved after surgical intervention. Overall,
in 20 eyes (77%), retinal attachment was achieved after surgical intervention. Overall, in 20 eyes (77%), retinal attachment was achieved in a single operation and, in 23 eyes (88%), retinal attachment occurred after multiple procedures. The retina failed to reattach in 3 eyes (12%) after 23-gauge vitrectomy and additional operations. These 3 eyes had retinal breaks either before or after vitrectomy. Postoperative compli-
cations occurred in some infants. Disc dragging was noted in 5 eyes (19%) during follow-up. Four eyes (15%) de-
veloped cataracts and underwent subsequent cataract op-
erations. Two eyes (8%) developed glaucoma during post-
operative follow-up and underwent filtering surgical pro-
cedures after medical therapy failed. Persistent vit-
reous hemorrhage was noted in 1 eye (4%); an addi-
tional vitrectomy was performed to clear the hemor-
 rhage. Posterior iris synechia occurred in 1 eye (4%) during follow-up. None of the patients developed endophthalmitis during follow-up.

COMMENT

Vitreous operations in infant eyes remain challenging. Because newborn eyes are much smaller than adult eyes, the anatomy and the surgical approach are different. Instruments are also adjusted for use in smaller eyes. Most important, the chance to amend undesirable complica-
tions, ie, retinal break, is much slimmer. Therefore, a bet-
ter approach that offers both safety and efficacy is sorely
needed.

Modifications of smaller-gauge vitrectomy are neces-
sary in ROP because of these differences. We have made
several modifications. First, sclerotomies are made in the
pars plicata because of underdevelopment of the pars plana
in newborns.23 The MVR blade should be directed in a
more perpendicular direction to reduce the chance of lens
damage.20 Second, trocars are not used in newborn eyes
because of the chance that the retina could be damaged
d by distortion of the globe during insertion of trocars into
such small eyes. Third, the 23-gauge infusion cannula is
replaced with a smaller anterior chamber maintainer so
that a contact prism lens or a wide-angle viewing lens
can be placed on the cornea without bumping the infu-
sion or other instruments. Fourth, sclerotomies and conj-
unctiva are sutured to ensure wound integrity. Self-
sealing of sclerotomy wounds may be difficult; adequate
coverage of the conjunctiva is not always possible be-
cause of proximity of the wound to the limbus. In addi-
tion, we are concerned about the integrity of the wound
if left unsutured because of the potential harm when in-
fants cry and strain during eye examinations. In our cases,
we did not encounter postoperative hypotony or endoph-
thalmitis during the follow-up period.

Because it is important to plan for ROP repair before
the intervention, anesthetists are consulted beforehand
to evaluate the risk of general anesthesia. This is necessary because the operation may need to be postponed if the infant’s condition is unstable. If plus or pre-plus disease is noted on the fundus, bevacizumab is injected less than 1 week before vitrectomy. Hemorrhage in the vitreous or in the proliferative fibrovascular membranes during vitreous shaving in the course of the subsequent vitrectomy could be reduced. Although angiogenesis is inhibited after bevacizumab use, the fibrotic component of ROP may accelerate and retinal detachment might worsen. Thus, we suggest that vitrectomy be performed within 1 week of bevacizumab injection. If patients have received scleral buckling beforehand, the division of buckling material is performed before vitrectomy. Before the operation, the fundus is checked again to determine the configuration of retinal detachment. The area with the least retinal dragging is selected as the infusion site. The vectors that involve tractional force on the retina are dissected until the surgeon determines that the force was relieved by the vitreous cutter. Aggressive membrane peeling is avoided, and efforts are made to reduce the possibility of iatrogenic break, which usually carries a poor prognosis. Retinal flattening takes several months because of the exudative component in the subretinal space. Documentation of the surgical procedure is important and is done using a video recording system.

The benefits of 23-gauge vitrectomy compared with traditional 20-gauge vitrectomy for ROP include easier insertion of the instrument because of its smaller size, more working space in the vitreous as a result of the use

<table>
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<tr>
<th>Patient/ Sex, Eye</th>
<th>GAB, wk</th>
<th>BW, g</th>
<th>PMS, wk</th>
<th>Stage</th>
<th>Zone</th>
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<td>1328</td>
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Abbreviations: BW, birth weight; GAB, gestational age at birth; PMS, postmenstrual age at surgery; ROP, retinopathy of prematurity; RRD, rhegmatogenous retinal detachment; VH, vitreous hemorrhage.
of a smaller vitrectomy probe, a cutting port that is closer to the retina, and a higher cutting speed with less vitreous traction during the procedure. Surgeons could adapt to this technique easily because the setup of this system is similar to that of traditional 20-gauge vitrectomy. Safety has also been enhanced with a smaller infusion line in the pediatric eye. The drawback of this system is the higher expense associated with 23-gauge vitrectomy systems.

The potential benefits of 23-gauge vitrectomy compared with 25-gauge vitrectomy include a sturdier probe, which facilitates eye rotation; higher cutting efficiency because of a larger port in the cutter; better instrument manipulation, thus avoiding damage to the lens and retina; and a better lighting source that allows for clearer visualization of the fundus. The need for an additional operation is also reduced. Gonzales et al. reported that 47% of eyes undergoing 25-gauge vitrectomy for stages 4 and 5 ROP require more than 1 retinal operation for persistent retinal detachment and/or vitreous hemorrhage. Of our patients, only 6 eyes (23%) needed more than 1 retinal operation for persistent retinal detachment and/or vitreous hemorrhage. The drawback of this system compared with 25-gauge vitrectomy is the need to dissect the conjunctiva and the suturing of sclerotomies and conjunctiva. In addition, mild leakage from the sclerotome site occurs because of the 20-gauge MVR blade.

Our anatomic success is comparable to that of previous reports on procedures using a 20- or 25-gauge vitrectomy probe. The retina failed to reattach in 3 eyes (12%) after 23-gauge vitrectomy and additional surgical procedures. All 3 eyes had retinal breaks either before or after vitrectomy. One patient with stage 4B ROP was found to have rhegmatogenous retinal detachment before vitrectomy. That infant had undergone laser treatment twice before vitrectomy. The retinal break could have been caused by excessive laser energy. The other 2 patients developed retinal breaks after vitrectomy, possibly related to vitrectomy, gas-fluid exchange, or existing breaks that were not identified during vitrectomy. Unfortunately, repeated procedures failed to reattach the retina. It is difficult to compare the results of other studies because of the heterogeneity of study populations and previous treatments. Some cases might not be suitable for the system described here if they are associated with significant anterior proliferation. With increasingly more 23-gauge instruments available, intervention in more difficult cases, ie, with ROP with denser membranes, could be attempted with the current system. Furthermore, because the sclerotomy was made using a 20-gauge MVR, 20-gauge instruments, such as the membrane peeler cutter scissors, could be used as a backup if there is a need to dissect heavy membranes.

Our study is limited by its retrospective design, small number of patients, and limited follow-up. We have made several modifications to the 23-gauge vitrectomy system in infant eyes. Information on the functional outcome of this technique is not yet available. The current system offers an acceptable surgical outcome and a good safety profile. The modifications we implemented worked well in our initial experience. However, no definitive conclusion could be drawn, as long-term results are available.

In conclusion, this modified 23-gauge vitrectomy in neonates offers better manipulation and better illumination than the 25-gauge vitrectomy. Moreover, this system provides a larger working space and reduced peripheral retinal traction with a high-speed vitrectomy probe and a smaller instrument size than that involved in traditional 20-gauge vitrectomy. Use of 23-gauge vitrectomy for retinal detachment in ROP seems to achieve an excellent balance between the results of 20- and 25-gauge vitrectomy. The anatomic success and complication rates are comparable to those in studies that used the traditional 20-gauge vitrectomy system.

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REFERENCES


Metastatic Breast Cancer to the Eyelid
Swetangi D. Bhaleeya, MD
Harry H. Brown, MD
Abraham J. Park, BA

A 49-year-old woman was seen for an eyelid lesion she noticed 5 months prior to presentation (A). Histological examination showed solid nests of epithelioid-appearing cells with large nuclei (B) (hematoxylin-eosin, original magnification ×200); morphology and immunohistochemical staining (inset: cytokeratin 7, original magnification ×100) was consistent with metastatic breast carcinoma.