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

Wei-Chi Wu, MD, PhD; Chi-Chun Lai, MD; Rey-In Lin, MD; Nan-Kai Wang, MD; An-Ning Chao, MD; Kuan-Jen Chen, MD; Tun-Lu Chen, MD; Yih-Shiou Hwang, MD

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 synchiae (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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RETINOPIA OF PREMATURITY (ROP) remains one of the leading causes of childhood blindness worldwide. Surgical intervention is indicated once stage 4 or stage 5 ROP with retinal detachment occurs. Surgical procedures should be performed as early as possible when retinal detachment develops because the prognosis of stage 4 ROP is much better than that of stage 5 ROP. For stage 4 ROP, both scleral buckling and vitrectomy have been used to treat retinal detachment.1-10 Scleral buckling achieves moderate anatomic success but is limited by a high incidence of induced refractive errors and the need for additional procedures to dissect or remove the buckling material.8,11 Recently, vitrectomy has become popular for the treatment of stage 4 ROP because of improved instrumentation and the ability to directly release transvitreal traction resulting from fibrous proliferation. Vitrectomy has a more favorable anatomic success rate (70%-95%) compared with scleral buckling.2,4,6,9,10,12,13 Functional outcome is even more impressive for stage 4A ROP treated with vitrectomy, allowing patients to achieve an average visual acuity of 20/58 to 20/62.4,14 Newer, smaller-gauge vitrectomy is becoming more popular than traditional 20-gauge vitrectomy for treatment of vitreoretinal disorders because of several potential benefits.15-19 The reported advantages in adults are reduced surgical time achieved with the sutureless nature of this system, increased patient comfort, faster visual recovery, and low complication rate. Smaller instruments might have additional advantages in infants with ROP.

There are few reports20,22 of surgical management of ROP using 25-gauge instruments with various modifications. However, the efficiency of such a system seems to be limited because 47% of eyes require multiple operations when 25-
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 23-gauge vitrectomy machine (Accu-scrus; Alcon, Fort Worth, Texas) placed on the cornea without bumping the infusion cannula or other instruments.

**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 surgical 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 bevacizumab injection before vitrectomy. Scleral buckling had been performed in 4 eyes (15%) at other hospitals before 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 rhegmatogenous retinal detachment. For the other eyes, the retinal detachment was only tractional. Mean postmenstrual 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 reattach the retina. One eye (4%) with stage 4A ROP progressed to stage 5 ROP, and successful retinal reattachment was achieved after surgical intervention. Overall, in 20 eyes (77%), retinal attachment was achieved after surgical intervention. 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 complications occurred in some infants. Disc dragging was noted in 5 eyes (19%) during follow-up. Four eyes (15%) developed cataracts and underwent subsequent cataract operations. Two eyes (8%) developed glaucoma during postoperative follow-up and underwent filtering surgical procedures after medical therapy failed. Persistent vitreous hemorrhage was noted in 1 eye (4%); an additional vitrectomy was performed to clear the hemorrhage. 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 complications, ie, retinal break, is much slimmer. Therefore, a better approach that offers both safety and efficacy is sorely needed.

Modifications of smaller-gauge vitrectomy are necessary 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 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 infusion or other instruments. Fourth, sclerotomies and conjunctiva are sutured to ensure wound integrity. Self-sealing of sclerotomy wounds may be difficult; adequate coverage of the conjunctiva is not always possible because of proximity of the wound to the limbus. In addition, we are concerned about the integrity of the wound if left unsutured because of the potential harm when infants cry and strain during eye examinations. In our cases, we did not encounter postoperative hypotony or endophthalmitis 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.24 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

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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 vitrec-
tomy. Safety has also been enhanced with a smaller infu-
sion line in the pediatric eye. The drawback of this sys-
tem is the higher expense associated with 23-gauge
vitrectomy systems.

The potential benefits of 23-gauge vitrectomy com-
pared 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 visu-
alization of the fundus. The need for an additional op-
eration is also reduced. Gonzales et al22 reported that 47%
of eyes undergoing 25-gauge vitrectomy for stages 4 and
5 ROP require more than 1 retinal operation for per-
sistent retinal detachment and/or vitreous hemorrhage. Of
our patients, only 6 eyes (23%) needed more than 1 reti-
nal operation for persistent retinal detachment and/or vitre-
ous hemorrhage. The drawback of this system com-
pared with 25-gauge vitrectomy is the need to dissect the
conjunctiva and the suturing of sclerотomies and con-
junctiva. In addition, mild leakage from the sclerotomy
site occurs because of the 20-gauge MVR blade.

Our anatomic success is comparable to that of previ-
ous reports2,4-6,9,10,12,13,20-22 on procedures using a 20- or
25-gauge vitrectomy probe. The retina failed to reattach
in 3 eyes (12%) after 23-gauge vitrectomy and addi-
tional 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 de-
tachment 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 vitrec-
tomy, possibly related to vitrectomy, gas-fluid ex-
change, or existing breaks that were not identified dur-
ing vitrectomy. Unfortunately, repeated procedures failed
to reattach the retina. It is difficult to compare the re-
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, in-
tervention in more difficult cases, ie, with ROP with denser
membranes, could be attempted with the current sys-
tem. Furthermore, because the sclerotomy was made using
a 20-gauge MVR, 20-gauge instruments, such as the mem-
brane 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 of-
fers an acceptable surgical outcome and a good safety pro-
file. 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 illumina-
tion than the 25-gauge vitrectomy. Moreover, this sys-
tem provides a larger working space and reduced pe-
ripheral 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 vi-
trectomy for retinal detachment in ROP seems to achieve
an excellent balance between the results of 20- and 25-
gauge vitrectomy. The anatomic success and complica-
tion rates are comparable to those in studies that used
the traditional 20-gauge vitrectomy system.

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Correspondence: Wei-Chi Wu, MD, PhD, Department
of Ophthalmology, Chang Gung Memorial Hospital,
Taoyuan, Taiwan (weich666@gmail.com).

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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.