AMERICAN ACADEMY™
OF OPHTHALMOLOGY

Immediate Sequential Bilateral Pediatric Vitreoretinal Surgery

An International Multicenter Study

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Purpose: To determine the feasibility and safety of bilateral simultaneous vitreoretinal surgery in pediatric patients.

Design: International, multicenter, interventional, retrospective case series.

Participants: Patients 17 years of age or younger from 24 centers worldwide who underwent immediate sequential bilateral vitreoretinal surgery (ISBVS)—defined as vitrectomy, scleral buckle, or lensectomy using the vitreous cutter—performed in both eyes sequentially during the same anesthesia session.

Methods: Clinical history, surgical details and indications, time under anesthesia, and intraoperative and postoperative ophthalmic and systemic adverse events were reviewed.

Main Outcome Measures: Ocular and systemic adverse events.

Results: A total of 344 surgeries from 172 ISBVS procedures in 167 patients were included in the study. The mean age of the cohort was 1.3±2.6 years. Nonexclusive indications for ISBVS were rapidly progressive disease (74.6%), systemic morbidity placing the child at high anesthesia risk (76.0%), and residence remote from surgery location (30.2%). The most common diagnoses were retinopathy of prematurity (ROP; 72.7% [$P < 0.01$]; stage 3, 4.8%; stage 4A, 44.4%; stage 4B, 22.4%; stage 5, 26.4%), familial exudative vitreoretinopathy (7.0%), abusive head trauma (4.1%), persistent fetal vasculature (3.5%), congenital cataract (1.7%), posterior capsular opacification (1.7%), rhegmatogenous retinal detachment (1.7%), congenital X-linked retinoschisis (1.2%), Norrie disease (2.3%), and viral retinitis (1.2%). Mean surgical time was 143±59 minutes for both eyes. Higher ROP stage correlated with longer surgical time ($P = 0.02$). There were no reported intraoperative ocular complications. During the immediate postoperative period, 2 eyes from different patients demonstrated unilateral vitreous hemorrhage (0.6%). No cases of endophthalmitis, choroidal hemorrhage, or hypotony occurred. Mean total anesthesia time was 203±87 minutes. There were no cases of anesthesia-related death, malignant hyperthermia, anaphylaxis, or cardiac event. There was 1 case of reintubation (0.6%) and 1 case of prolonged oxygen desaturation (0.6%). Mean follow-up after surgery was 103 weeks, and anatomic success and globe salvage rates were 89.8% and 98.0%, respectively.

Conclusions: This study found ISBVS to be a feasible and safe treatment paradigm for pediatric patients with bilateral vitreoretinal pathologic features when repeated general anesthesia is undesirable or impractical. *Ophthalmology 2016;■:1–8 © 2016 by the American Academy of Ophthalmology.*

Bilateral involvement is common in pediatric vitreoretinopathies. Systemic aberrations often predispose both eyes to pathologic features, such as premature birth in retinopathy of prematurity (ROP), *Wnt* signaling defects in familial exudative vitreoretinopathy, and trauma in abusive head trauma (formerly shaken baby syndrome). Furthermore, pediatric vitreoretinal surgical patients present unique challenges. Many—especially premature infants—are systemically fragile with multiple life-threatening comorbidities. They are at high anesthesia risk, and repeated sessions

http://dx.doi.org/10.1016/j.ophtha.2016.04.033
ISSN 0161-6420/16

of general anesthesia are undesirable, or occasionally simply not possible.[1–3] Second, some pediatric vitreoretinopathies, such as ROP, are prone to rapid symmetrical bilateral progression. Delayed surgical intervention may decrease the likelihood of optimal outcome for the second eye, increasing the probability of life-long visual impairment or blindness.[4] Third, relatively few centers specialize in the management of pediatric vitreoretinal surgical diseases.[5] A single surgeon or surgical group may draw patients from several states in the United States, or several countries globally. Consequently, the financial challenges posed by out-of-state or out-of-country care with regard to treatment and travel may be prohibitive for repeated visits for a second eye. A single session of general anesthesia to repair both eyes addresses all 3 issues.

Although the rationale outlined just above may be compelling, bilateral same-day intraocular surgery is a controversial topic. Under most circumstances, surgeons stage bilateral surgery by intervening first in the eye in which visual potential is greater and is threatened more urgently, deferring the fellow eye for a separate surgical intervention days or weeks later. This is the standard of care for intraocular surgery in most countries, primarily because of concerns regarding potential complications such as endophthalmitis and toxic anterior segment syndrome.[6–8] Interestingly, bilateral intravitreal injections are performed routinely in many practices, and injections have similar rates of endophthalmitis compared with intraocular surgeries.[9,10]

The debate is most mature as it relates to cataract surgery.[6–8,11] The most updated nomenclature for this practice is *immediate sequential bilateral cataract surgery* (ISBCS). Numerous centers have published their experiences with reported benefits of faster visual recovery and time convenience.[12–16] Immediate sequential bilateral cataract surgery in children also has been reported.[17–19] However, immediate sequential bilateral vitreoretinal surgery (ISBVS) is addressed rarely in the literature,[20] despite pediatric vitreoretinal surgeons anecdotally performing ISBVS for years. We propose ISBVS as a management paradigm for certain pediatric patients, not for convenience or faster recovery, but rather because the probability of optimal ophthalmic outcomes is increased, while systemic risk of morbidity and mortality and financial barriers to specialized surgical care are minimized.

Methods

This study was an international, multicenter, interventional, retrospective case series of pediatric patients (17 years of age or younger at the time of surgery) who underwent ISBVS, defined as vitrectomy, scleral buckle, or lensectomy using the vitreous cutter, performed in both eyes sequentially during the same anesthesia session. Intravitreal injections, indirect laser treatments, and cataract extraction without a vitreous cutter were excluded. Participants were identified via billing codes and surgical logs, with no limitation to the date of surgery. Institutional review board or ethics committee approval was obtained at each participating institution. The study complied with the Health Insurance Portability and Accountability Act of 1996 and adhered to the tenets of the Declaration of Helsinki.

Data collection included demographic information, diagnoses, clinical histories, indications for ISBVS, surgical details, precautions taken against cross-contamination between eyes, operative time, time under anesthesia, intraoperative and postoperative ($\leq$30 days) ocular and systemic adverse events, anatomic and visual outcomes, and need for further surgeries. Snellen and decimal visual acuities were converted to logarithm of the minimum angle of resolution units for statistical analyses. The binomial test was used for single population categorical dependent variables, and the Spearman rank correlation coefficient was used for nonparametric correlation testing. Statistical tests were 2-tailed and significance was defined as $P < 0.05$. Stata software version 9.0 (StataCorp, LP, College Station, TX) was used for statistical analyses.

Results

We identified 167 patients who underwent 172 ISBVS sessions (5 patients underwent ISBVS twice), for a total of 344 vitreoretinal surgeries. The mean chronologic age of the cohort was 1.3±2.6 years (median, 17.7 weeks; range, 4.0 weeks−13.2 years). Other demographic data are presented in Table 1. Most surgeries in our collaborative group were performed in the United States and East Asia. The dates of surgery ranged from 2002 through 2015.

Indications

The nonexclusive indications (many patients had more than 1 indication) for ISBVS were rapidly progressive disease (74.6%), systemic morbidity placing the child at high risk for general anesthesia (76.0%), residence remote from location of surgery (30.2%), and limited financial resources (4.1%). The diagnoses of the patients undergoing ISBVS are summarized in Table 2. More than half of the surgeries were for patients with ROP ($P < 0.01$).

Focus on Retinopathy of Prematurity

Immediate sequential bilateral vitreoretinal surgery for ROP was performed in 250 eyes of 120 infants (Fig 1). The mean gestational age was 26.3 ± 3.6 weeks (range, 22−38 weeks), and mean birth weight was 930.1±553.9 g (range, 308−3500 g). Prior laser photocoagulation, intravitreal anti−vascular endothelial growth

Table 1. Demographics of Patients Undergoing Immediate Sequential Bilateral Pediatric Vitreoretinal Surgery

Feature	No. of Eyes (%)
Age (yrs)	
Mean (range)	1.3 (0.1−13.2)
Gender	
Male	102 (61.1)
Female	65 (38.9)
Race	
Asian	79 (47.3)
White	63 (37.7)
Black	14 (8.4)
Latino	10 (6.0)
Unknown	1 (0.6)
Location of surgery	
United States	87 (52.1)
East Asia	67 (40.1)
South Asia	7 (4.2)
United Kingdom	6 (3.6)