A small retinoblastoma (<1 disk diameter) was found at 4 o'clock in the right peripheral retina, close to the ora serrata (Figure 1B). Triple freeze-thaw cryotherapy was applied due to the anterior location, and the child was re-examined under anesthesia 6 weeks later. Within the cryotherapy scar, residual tumor was seen and was treated with repeat cryotherapy (Figure 2A). Two further examinations under anesthesia revealed no recurrence or new tumors, with last follow-up 8 months after the first treatment (Figure 2B). The patient tolerated the procedures well, with no regression after anesthesia.

Discussion

It is likely that, had this child's tumor not been found through information at hand, he would have presented later in a more serious and less manageable condition.[2] Screening for high-risk tumors includes examination under anesthesia beginning at 8 weeks of age, with monthly examinations until age 1 year and subsequently every 2 months from 1 to 2 years, every 3 months from 2 to 3 years, every 4 months from 3 to 4 years, and every 6 months from 4 to 5 years.[6] Examinations can be performed without anesthesia in cooperative older children. The location of retinoblastoma tumors is correlated with the maturation process of the retina, with tumors becoming increasingly peripheral with age.[7] After 2 years of age, 50% of detected tumors are found in the far periphery; this trend led us to pursue a definitive diagnostic procedure.

In patients with known mitochondrial disorders, anesthesia principles include reducing mitochondrial stress through avoidance of metabolic acidosis, hypothermia, hypoglycemia, catabolism, and hypovolemia as well as minimizing pain, anxiety, nausea, and vomiting.[8] In our center, propofol is generally avoided, because prolonged use can result in metabolic acidosis, even in patients without baseline mitochondrial disorders.[9] During the patient's prior procedures, propofol was used for induction and maintenance. Of the volatile agents, sevoflurane in children with mitochondrial disorders undergoing muscle biopsy, with a mean anesthetic duration of 36 minutes, shows a good safety profile.[10]

The ambiguity of the actual mitochondrial disorder (LHON versus Leigh syndrome)[11] led to WES, which illustrates the expanding role of genetic testing in diagnosis and treatment of disease. Utilization of this technology requires the physician to play a crucial role in helping patients and families to understand and comprehend the advantages and liabilities of the complex information. Considerations include, but are not limited to, identification of variants of unknown significance, unmasking adult-onset disease in a pediatric population, discovery of disease with high familial penetrance, and identification of nonpaternity or consanguinity.

The study of genetics is increasingly incorporated in everyday medicine. With appropriate interdisciplinary discussion, outcomes can improve drastically in cases where genetic diagnoses inform ophthalmological examination and treatment. Pediatric ophthalmologists must continue to adapt to the unique challenges of these new directions.

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Successful treatment of an exudative choroidal hemangioma with oral propranolol in a 10-year-old boy

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Dr. Rajagopal is supported by NIH/NEI EY025269, a Career Development Award from Research to Prevent Blindness, and the Horncrest Foundation.

Submitted October 16, 2018.

Revision accepted February 3, 2019.

Published online April 5, 2019.

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J AAPOS 2019;23:236-238.

1091-8531/$36.00

https://doi.org/10.1016/j.jaapos.2019.02.004

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A 10-year-old boy was referred for a circumscribed choroidal hemangioma with underlying exudative detachment of the left eye. To avoid general anesthetics required for laser-based therapy in a child, we began a trial of oral propranolol. The patient's exudative detachment resolved, with resulting improvement in visual acuity, and remained quiescent for 3 years.

Case Report

A 10-year-old boy with a history of a circumscribed choroidal hemangioma involving the left eye presented at Washington University School of Medicine for progressive vision loss over several weeks. He had received regular eye examinations since 6 years of age for anisometropic amblyopia of the left eye and cup:disk ratio asymmetry. His baseline visual acuity was 20/20 in the right eye and 20/25 in the left eye. Over the prior 5 years his examination showed a stable cup:disk ratio and corneal diameter in both eyes, suggesting no glaucomatous progression.

On examination, his visual acuity was 20/50 in the left eye and had remained 20/20 in the right eye. Tonometry was normal in both eyes. Pupillary light responses, ocular motility, confrontational visual fields, and slit-lamp examination were unremarkable. Retinal examination of the left eye revealed a circumscribed choroidal hemangioma with superior exudative detachment involving the macula (Figure 1A). Retinal examination of the right eye was normal. The lesion in the left eye demonstrated diffuse leakage of fluorescein (Figure 1B). Whereas retinal architecture was normal in the right eye (Figure 2A), a subfoveal serous neurosensory detachment was present in the left eye (Figure 2B).

We considered several options for treatment, including treatment with photodynamic therapy (PDT) and thermal laser photocoagulation, which are both standard therapies in adults. However, we elected to begin a trial of oral propranolol to avoid anesthetics required for laser-based therapy in children. Oral propranolol was administered at a dose of 2 mg/kg/day for one month. The child experienced no serious adverse side effects, but his parents noted a decrease in his exercise tolerance and a mild increase in his fatigability. His propranolol dose was subsequently tapered down and eventually discontinued over another 4 weeks. Three months after the initiation of therapy, his exudative retinal detachment resolved (Figure 2C) and his visual acuity improved to 20/25. The patient's choroidal lesions remained quiescent for at least 3 years thereafter without recurrence of subretinal fluid.

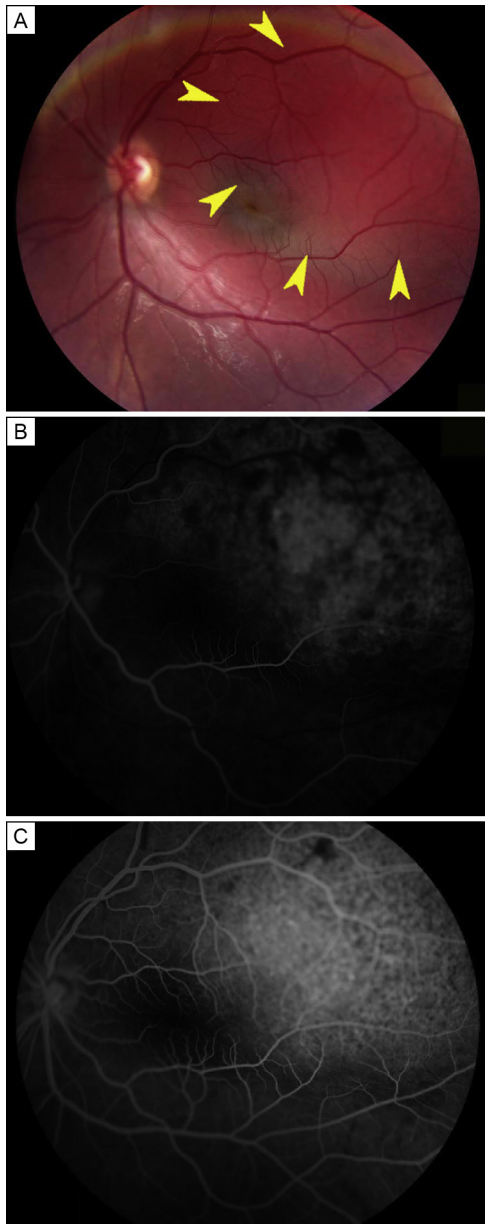

FIG 1. Choroidal hemangioma in a 10-year-old boy. A, Retinal photograph of the left eye, showing a circumscribed choroidal hemangioma, with exudative retinal detachment superotemporal to and involving the macula (arrowheads). B, Early-phase fluorescein angiogram of the left eye, with coarse hyperfluorescence of the lesion C, Late-phase fluorescein angiogram of the left eye, demonstrating leakage consistent with an exudative detachment.

Discussion

Circumscribed choroidal hemangiomas are rare, isolated, benign vascular hamartomas. Histologically they are comprised of capillary and cavernous vascular networks.[1] Clinically they appear as orange-red, solitary lesions, sometimes associated with serous retinal detachments.[2] Although these lesions may be asymptomatic and found

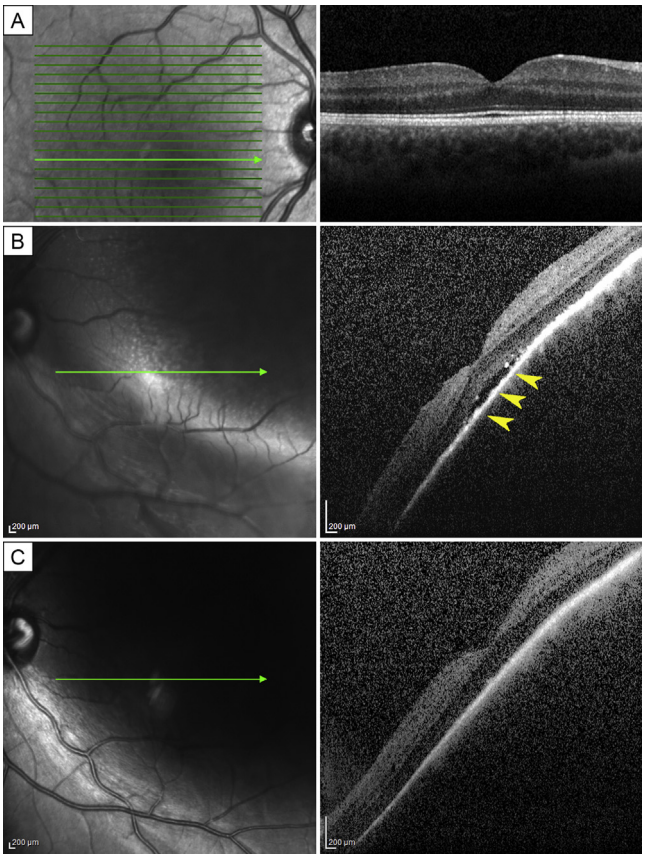

FIG 2. Response to therapy with propranolol. A, Optical coherence tomography (OCT) of the right eye showing normal retinal architecture. B, OCT of the left eye prior to therapy showing a pocket of subfoveal fluid (arrowheads). C, OCT 3 months after starting oral propranolol, with resolution of subretinal fluid.

incidentally on routine clinical examination, the majority of patients in a large series reported decreased vision.[3]

Established treatment modalities for symptomatic lesions include thermal laser photocoagulation and PDT, although antivascular endothelial growth factors have also been employed successfully.[2-5] However, in pediatric patients, these methods require use of general anesthetic.

Oral propranolol is a first-line therapy to treat infantile capillary hemangiomas. As a nonselective beta-2 blocker, it functions to reduce nitric oxide release and proangiogenic molecules, including hypoxia-inducible factor 1 and vascular endothelial growth factor, ultimately resulting in apoptosis of capillary endothelial cells.[1,6] This drug has been used to treat exudative retinal detachments related to circumscribed choroidal hemangiomas in adults with variable success. Sanz-Marco and colleagues[1] reported resolution of subretinal fluid and improvement of visual acuity to 20/20 from 20/100 using the same dose of propranolol. However, a study of 5 adults treated with propranolol for long-standing exudative detachments from choroidal hemangiomas found improvement in, but not resolution of, subretinal fluid volume on a maximum of 30 mg propranolol three times daily.[5] However, caveats of this study are the inclusion of chronic cases and the use of a low and potentially subtherapeutic dosage of propranolol.

Our patient presented at 10 years of age with a visually significant circumscribed choroidal hemangioma, with secondary exudative retinal detachment. A trial of oral propranolol was appropriate, because alternative treatments would have required use of general anesthetic. Using a weight-based dosage, our patient's subretinal fluid resolved, and his visual acuity improved to near baseline. Furthermore, his choroidal hemangioma remained stable for at least 3 years.

In the pediatric population, oral propranolol offers a relatively safe potential therapy for exudative retinal detachments related to circumscribed choroidal hemangiomas. As in our patient, this therapy may improve subretinal fluid accumulation and visual acuity in pediatric patients. A trial of oral propranolol may be considered prior to undertaking alternative therapies, such as laser therapy or intravitreal injections, which require general anesthesia.

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Juvenile idiopathic arthritis–related uveitis mimicking endophthalmitis

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Submitted July 23, 2018.
Revision accepted March 21, 2019.
Published online April 5, 2019.

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J AAPOS 2019;23:238-241.

1091-8531/$36.00
https://doi.org/10.1016/j.jaapos.2019.03.001