

Progress in ROP Management Through Tele-ophthalmology

The portable RetCam Shuttle and the iPhone are helping physicians and trained technicians manage ROP in the vast underserved rural areas of India.

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Approximately 16,000 premature infants are affected by retinopathy of prematurity (ROP) in the United States every year.¹ Screening guidelines for ROP in the United States stipulate that ROP screening be performed by experienced ophthalmologists using binocular indirect ophthalmoscopy (BIO).² In middle income and emerging economies, such as India or Latin America, where the majority of the reported 50,000 children who are blind from ROP worldwide reside, screening guidelines for ROP must be more broad, Anand Vinekar, MD, FRCS, of Narayana Nethralaya Postgraduate Institute of Ophthalmology in Bangalore, India, said at the American Academy of Ophthalmology Annual Meeting in Chicago.^{3,4}

Ideally, all babies in India with a birth weight less than 2,000 g should be screened by an ROP-trained ophthalmologist within the first 4 weeks of life, with subsequent screenings determined by the initial findings.⁵ Unfortunately, applying this *ideal* model is extremely difficult in a country with few ROP-trained ophthalmologists, limited resources, and a plethora of underserved areas, Dr. Vinekar said.

"In India, we have 1.2 billion people and 400 retinal surgeons. Fewer than 15 of these surgeons practice comprehensive ROP care," Dr. Vinekar said in his presentation. "We have 27 million live births per year. Around 2 million of these are born weighing less than 2,000 g and are at risk of ROP. This means that one in two babies (47%) will develop some ROP and about 15% to 20% of them will require treatment. In fact, every 2 hours, somewhere in India, three babies require treatment."

Possible reasons for the dramatic difference between rates of ROP in low-income countries compared with the United States and other developed countries include higher birth rates and higher rates of premature births; insufficient resources for neonatal care, which leads to higher rates of severe ROP in premature and mature infants; and a shortage of screening and treatment programs due to lack of awareness, lack of skilled personnel, and financial constraints.⁵

TELE-OPHTHALMOLOGY FOR ROP SCREENING

The challenge, Dr. Vinekar said, is harnessing limited resources to reach rural areas and villages where infants do not receive the timely treatment necessary to prevent irreversible blindness. To address this challenge, Dr. Vinekar and colleagues developed a tele-ROP program called KIDROP (Karnataka Internet-Assisted Diagnosis of Retinopathy of Prematurity) in 2007. Specially trained technicians, who do not have a background in ophthalmology, use the portable RetCam Shuttle (Clarity Medical, Pleasanton, CA) to take wide-field digital fundus images of infants currently in 24 NICUs in several districts of Karnataka in a fixed-day, fixed-center program. Often, the centers are filled with mothers who travel 50 to 100 kilometers with their infants to be imaged by Dr. Vinekar's team. The program has now been approved as the country's first public-private partnership for infant blindness management, and it is anticipated to expand to 36 more NICUs over 12 more districts of the state and eventually other parts of the country, Dr. Vinekar said.



Figure 1. Digital images on the Retcam laptop are used to educate mothers gathered for imaging their infants in a rural NICU in Southern Karnataka about the blindness potential of ROP and the need for follow-up.

PORTABLE IMAGING

The RetCam is a fully integrated wide-field digital imaging system capable of capturing ophthalmic images from premature infants and children (Figure 1). The Shuttle version is easily transportable between hospitals and clinics. The digital images can be transferred to any networked system for timely transmission of patient images to experts, who can then view and evaluate them remotely (Figure 2). Studies have demonstrated that the RetCam can detect all cases of ROP in which treatment is a necessity.⁶ Additionally, digital imaging with the RetCam requires significantly less time compared with BIO examination.⁷

To identify infants at risk of ROP, the technicians capture, process, and store the images. They have been specifically trained to triage the infants they screen with a three-colored flag system. A red flag represents infants whose images demand urgent attention by a retinal physician. These include eyes that potentially have reached the stage of treatment-requiring disease or high-risk prethreshold. An orange flag refers to milder ROP that needs follow-up on a nonemergent basis. A green flag denotes a fully mature or normal fundus. These babies can be discharged from ROP screening if imaging ora serrata in all quadrants confirms a disease-free state up to the peripheral retina. With increasing numbers, the team's technicians have become adept at imaging the peripheral retina in almost all cases. Dr. Vinekar's team has thus far imaged over 3,000 infants serially and possesses a database of over 200,000 images. With this system of triage, ophthalmologists specializing in ROP care need to address only the difficult cases or those that require treatment.



Figure 2. Trained technicians (background) image infants on a make-shift table using the Retcam Shuttle at a rural NICU, while the project manager (foreground) uploads the images on the server for the remote expert to view and evaluate.

"We understand that this may not be a model for the developed world—technicians imaging and reporting—but in the scenario of India and other middle-income countries, there simply is no other way, where there are massive numbers of infants that need to be screened and a limited number of trained physicians," Dr. Vinekar said. "Since the program began, more than 3,240 infants have been screened and about 354 have been treated for ROP." As of October, Dr. Vinekar's team had gone through more than 15,000 infant imaging sessions and captured more than 14 images for both eyes of all infants screened. In the past 27 months, the team has traveled over 120,000 kilometers into rural areas to more than 24 centers and has initiated screening and treatment centers where no ROP screening had happened before. The large numbers, he said, are a sign of the unmet need where even heavier and more mature babies are developing ROP in developing countries compared with the Western world.⁸

SPEEDING UP THE PROCESS

In an effort to improve time and reporting flow, the Narayana Nethralaya Postgraduate Institute recently partnered with i2i TeleSolutions (Bangalore, India) to develop telemedicine software for the iPhone (Apple, Inc., Cupertino, CA). Technicians upload scanned retinal images onto a secure dedicated server. A physician can remotely access the side-by-side images, diagnose, and recommend treatment with the iPhone.

"The heart of the application is the ability to report live images using the cellular network instead of the Internet," Dr. Vinekar said. "While everyone else is worried about downloading speeds, what we are really wor-

ried about is uploading speeds. With the variable and slow Internet speeds we have in some of the rural areas of India, this is quite a challenge. We recently tested the 3G capability of the iPhone and on the iPad (Apple) and found it obviously to be most useful." Dr. Vinekar said that the Internet speeds in the rural parts of India continues to be a challenge but is a work in progress. India is poised to introduce a cellular 3G network nationwide by the end of 2010, and this will positively affect the telemedicine progress, he said.

MAKING AN IMPACT

The impact that the tele-ophthalmology program has made in Indian society is profound and measurable, Dr. Vinekar said. "In the past 27 months, we have treated 354 infants. These babies, who have their eyesight, will go on to earn about 38,000 rupees per capita income and live for an average of 65 years. This equals approximately 18 or 19 million dollars saved for the federal government for an investment of half a million."

The Ministry of External Affairs of India, has recognized this initiative as a unique model for reaching the unserved citizens of rural India.⁹ This recognition bodes well, considering that the program is poised for nationwide expansion, Dr. Vinekar said.

"In a country where 22% of reported childhood blindness is attributable to retinal causes, what makes the tele-ROP initiative a promising one is the fact that a majority of the blindness burden is preventable," Dr. Vinekar concluded. "KIDROP has shown that with a synergy of innovation, customizable technology, and passion it is possible to reach the unreached. In a country that has done well managing cataract blindness over the past 4 decades, the need of the hour is to address the issue of other important causes of childhood blindness before the wave of the 'third epidemic' of ROP sweeps across India and the developing world." ■

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