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Case Report

Monitoring the Evolution of Stage IV-A Retinopathy of Prematurity Using Retinal Imaging: A Case Series

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Abstract

Amidst the growing Retinopathy of Prematurity (RoP) crisis in India, tele-screening has assumed an important role, enabling RoP practitioners to screen a large number of babies without the need to travel everywhere. Though Binocular Indirect Ophthalmoscopic (BIO) examination is the current gold-standard for RoP screening, RoP drawings have not been scientifically evaluated for accuracy. There is significant inter-observer variability in this method of documentation. Digital fundus imaging is reproducible, quick and additionally can help to detect minute changes in the disease state which are not so obvious on Indirect Ophthalmoscopy examination. Digital Fundus Imaging can also help in parent counselling and medicolegal documentation. We present three cases of peri-papillary volcano-type tractional retinal detachment which were serially monitored using fundus imaging. The 3Nethra Neo Fundus Camera by Forus Health, Bengaluru, India was utilized for screening these infants. It employs a light-weight, hand-held probe with an Light Emitting Diode (LED) light source for capturing images. Using this fundus camera, we monitored the evolution of these three cases and were able to observe a clear regression of the disease after RoP Laser. Surgical intervention was successfully avoided and these babies have remained stable. These results are all the more gratifying when we consider the surgical burden of RoP in India.

Keywords

Retinopathy of Prematurity, ROP, ROP Laser, Stage IV-A ROP

1. Introduction

Out of the 15 million preterm infants born worldwide every year, about 3.5 million are born in India [1]. Of these, it is estimated that at least 20,000 preterm infants require management for Retinopathy of Prematurity (RoP) per year [2].

Binocular Indirect Ophthalmoscopic (BIO) examination is the current gold-standard for RoP screening and findings are documented using retinal drawings. This method of screening and documentation has a significant inter-expert variability.

Digital retina imaging provides an objective documentation at a specific point in time. Wide-field fundus camera has become an essential tool in RoP screening, particularly in resource-poor areas. It can additionally be useful in sequential monitoring of disease progression.

We present three cases of Stage IV-A RoP, which have been monitored using wide-field retinal imaging.

2. Figures

Here are the figures.

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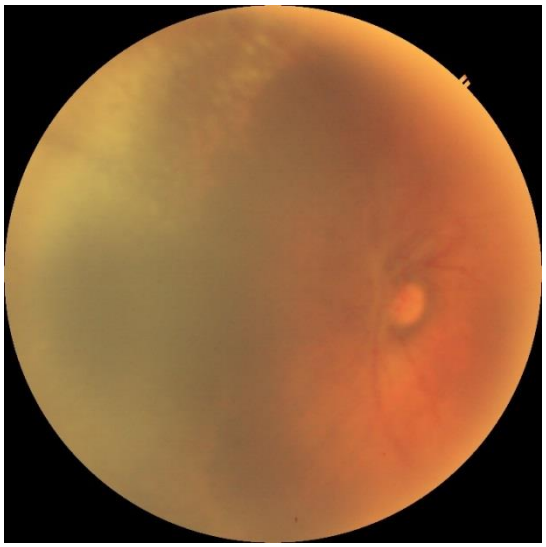

Figure 1. *Case 1- Baseline.*

Figure 2. *Case 1- At 1 month follow up.*

Figure 3. *Case 1- At 2 months follow up.*

Figure 4. *Case 2- Immediately following RoP Laser.*

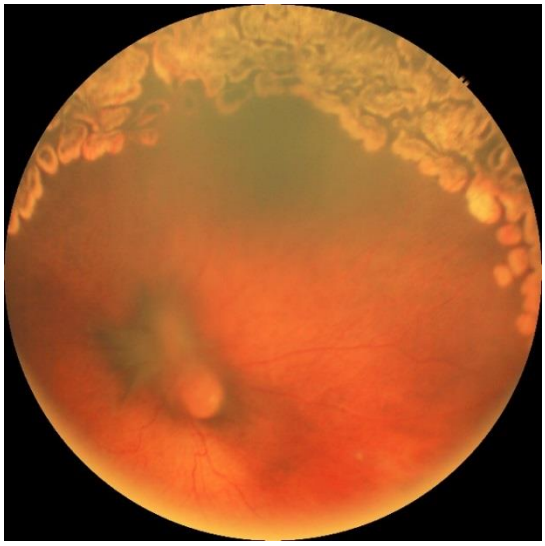

Figure 5. *Case 2- One month follow-up.*

Figure 6. *Case 2- Two month follow-up.*

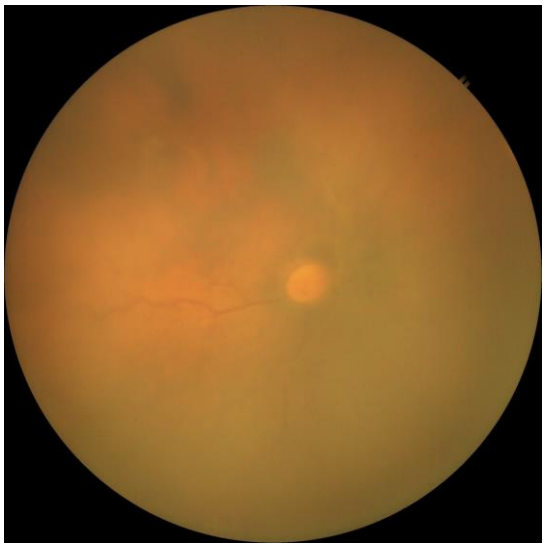

Figure 7. *Case 3- Immediately following RoP Laser.*

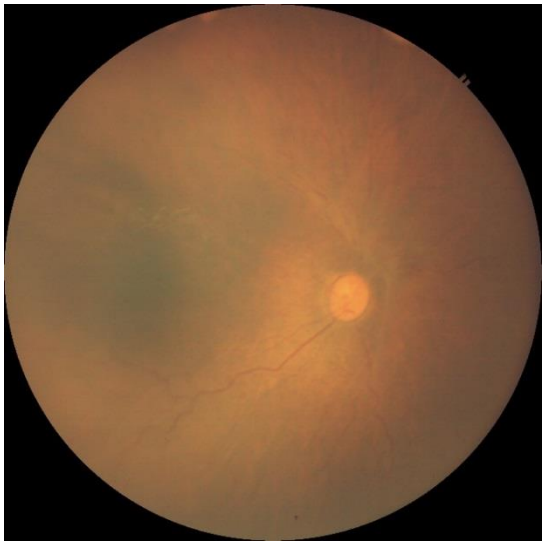

Figure 8. *Case 3- At one month follow up.*

Figure 9. *Case 3- At 2 month follow-up.*

3. Tables

Table 1. *Birth details.*

Case	Gestational age	Sex	Birth weight
1	30 weeks	Male	1600 gm
2	30 weeks	Female	1100 gm
3	29 weeks	Male	1170 gm

Table 2. *Course of the disease.*

Case	Course of the disease
1	Underwent RoP laser at 36 weeks in both eyes and referred for nasal TRD
2	First screened at 38 weeks and had nasal TRD with a small pre-retinal haemorrhage in left eye. Underwent RoP Laser on the same day
3	Diagnosed with Aggressive RoP at 32 weeks with vitreous haemorrhage in right eye. Received intravitreal bevacizumab in both eyes on the same day, RoP laser one week later. Nasal TRD noted in right eye one week after RoP Laser.

4. Materials and Methods

This study fulfilled the requirements of the hospital safety committee and the clinical research department and adhered to the tenets of the Declaration of Helsinki and was accepted by the Institute Research Board and the Institute Ethics Committee. Written, informed consent was obtained from parents of all the babies.

Fundus images were captured for three infants with peri-papillary volcano-type Tractional Retinal Detachment (TRD), a subset of Stage IV-A RoP, using the 3Nethra NEO Fundus Camera, developed by Forus Health Pvt Ltd, Bengaluru, India.

Qualitative assessment of fibrovascular proliferation (FVP) was done to note its site, vascularity and apparent traction produced. The tortuosity of retinal blood vessels was also noted.

Quantitative assessment was done to note the size of the proliferation. It was noted at each visit as the longest vertical x longest horizontal extent, expressed in terms of disc diameter.

5. Case Reports

Details of all three cases are mentioned in Table 1.

Case 1:

He had a nasal proliferation measuring about 3 disc diameters x 2 disc diameters.

At his follow up after two months, the size of the proliferation was noted to be around 1 disc diameter x 1.5 disc diameters, with a reduction in its vascularity (Figures 1-3).

Case 2:

At initial screening, size of the proliferation was about 2 disc diameter x 1.5 disc diameter.

On subsequent follow-ups, the tortuosity of the vessels reduced and the FVP gradually regressed to a predominantly fibrous one.

At her two month follow-up, the proliferation measured approximately 1.5 disc diameter x 1 disc diameter. The pre-retinal haemorrhage had resolved completely and there was a visible reduction in the vascularity of the proliferation. (Figures 4-6).

Case 3:

Initial size of FVP was approximately 2 disc diameter x 2.5 disc diameter.

At two month follow-up, the proliferation had visibly thinned out, having predominantly a fibrous component. Its size had reduced to less than 1.5 x 1.5 disc diameter. (Figures 7-9).

6. Discussion

Stage IV-A RoP is an indication for urgent surgical management. Ours being a tertiary centre, all three cases were referred to us primarily for surgical management.

RoP surgery is a complex vitreo-retinal procedure in itself and the scenario is further complicated when the risks of anaesthesia in a preterm infant are taken into consideration. Post-operative apnoea is one of the primary concerns in preterm infants receiving general anaesthesia and infants with post-conceptional age less than 46 weeks need to be monitored for at least 12 hours post-surgery, many of them needing Neonatal Intensive Care Unit (NICU) admission [3].

All three cases had peri-papillary volcano-type TRD, a type of Stage IV-A RoP. All three cases in our study were not fit for surgery when they first presented to our center. RoP Laser was employed in two cases (numbers 2 and 3) as a stop-gap measure, till fitness for surgery could be obtained, while case number 1 had undergone RoP Laser less than a week prior to presentation at our centre. In all three cases, we found, to our immense surprise, that the tractional retinal detachment settled and we were able to defer surgery in all three cases.

Using the 3NethraNEO fundus camera, we monitored the evolution of these three cases and were able to document a clear regression of the disease. These results are all the more gratifying when we consider the surgical burden of RoP in India.

When compared with RetCam, 3Nethra Neo captures images at a higher resolution (2040 x 2040 pixels for 3Nethra Neo versus 1600 x 1800 pixels for RetCam) [4]. The field of view (120 degrees for 3Nethra Neo and 130 degrees for RetCam) and the weight of the hand-held probes (740 gm for 3Nethra Neo and 800gm for RetCam) are comparable between the two devices [4]. 3Nethra Neo has an added advantage of incorporating a warm Light Emitting Diode (LED) light source, giving it a longer operational life when compared to the halogen light source in RetCam [4].

3Nethra Neo has been in use at our institute for the last six years and it has provided consistent, reproducible results for screening premature infants, both, at our institute and for tele-screening at rural centres. The device has a short learning curve, enabling technicians or healthcare workers without an ophthalmic background to become proficient in its use. 3Nethra Neo is also being used extensively in the Karnataka Internet Assisted Diagnosis for Retinopathy of Prematurity (KIDROP) programme for screening premature babies in NICUs in rural areas of Karnataka state in India [5].

Imaging with 3Nethra Neo was performed after pupillary dilatation and administering topical anaesthesia. Infant wire speculum was used on one eye at a time and no scleral depressor was used for imaging. The handheld probe enables quick capturing of images and easy comparison between visits. All the babies in our study were screened at our tertiary care institute.

A joint statement by the American Academy of Ophthalmology, the American Association for Paediatric Ophthalmology and Strabismus and the American Association of Certified Orthoptists advocated digital fundus imaging as a useful tool for documentation as well as for educating the NICU staff [6].

In an eloquent article, published in 2008, Dr Moshfeghi and Dr Capone have highlighted various causes of RoP screening crisis in the USA [7]. They had stressed on the need for co-operation between NICUs and RoP practitioners if the RoP crisis is to be resolved. The issues that they had highlighted, apply to India even today. The number of trained RoP practitioners is small and the number of NICUs is ever-increasing, with these facilities now being available even at taluka-level. In-person screening with BIO has, as a result, become even more challenging. Tele-screening has gained importance in this scenario, enabling a trained Ophthalmologist to screen multiple NICUs without the need to travel everywhere.

RoP drawings have not been scientifically evaluated for accuracy. There is considerable inter-observer variability when evaluating digital images, especially in Plus or Pre-plus cases [8]. This problem is bound to be compounded even more when hand-drawn images are employed. Moreover, we know that judging Plus disease just by viewing a single image is difficult and a follow-up set of images helps us to better understand the vascular changes. Digital fundus imaging also plays an important role in parent counselling, improving compliance to follow-ups and treatment. A good documentation of the initial and follow-up visits is invaluable from a medico-legal point-of-view.

The portable 3NethraNEO, valued at about 25,000 USD, is a cheaper alternative for RoP imaging as compared to RetCam Shuttle, valued at about 125,000 USD [9]. This indigenous fundus camera can further help in mitigating the cost of RoP

tele-screening. Digital images can be assessed and re-assessed to detect even minute changes which are often missed on BIO examination. It is also easier to ask other ophthalmology colleagues about their inputs on a particular case, using digital images.

7. Conclusions

Serial monitoring using fundus images has allowed us to evaluate the disease progression and safely avoid a complex surgical process in these babies. The 3Nethraneo has proven to be a convenient, cheap, easy-to-use, portable device for RoP screening, helping to evaluate response to treatment and detecting subtle changes in the disease state.

Abbreviations

ROP	Retinopathy of Prematurity
BIO	Binocular Indirect Ophthalmoscopy
TRD	Tractional Retinal Detachment
FVP	Fibro-Vascular Proliferation
NICU	Neonatal Intensive Care Unit

Author Contributions

Neha Joshi: Formal Analysis, Investigation, Writing – original draft

Anand Subramanyam: Conceptualization, Methodology, Data curation, Writing – review & editing

Sarvesh Tiwari: Conceptualization, Formal Analysis, Methodology

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Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Neha Joshi is a Senior Registrar in the Department of Vitreo-Retina at K.B. Haji Bachooali Charitable Ophthalmic and E.N.T. Hospital, Mumbai, India. She completed her Master of Surgery (Ophthalmology) from D.Y. Patil Medical College and Research Center, Pune in June, 2020 and a two-year fellowship in Vitreo-Retina from K.B. Haji Bachooali Charitable Ophthalmic and E.N.T. Hospital, Mumbai. She has conducted webinars for Ophthalmology Postgraduate students and has delivered talks at various conferences. She has also won numerous awards for paper and poster presentation at national-level conferences. Her areas of interest include Diabetic retinopathy, Age- related macular degeneration and uveitis.

Anand Subramanyam is an Ophthalmologist with over two decades of experience. He completed his Master of Surgery (Ophthalmology) from KEM Hospital, Mumbai, India followed by Super-specialty training in Vitreoretinal diseases and Surgery at the prestigious Sankara Nethralaya Institute in Chennai, the premier eye institute of India. He underwent further training at the L.V.Prasad Eye Institute at Hyderabad in the extremely critical field of Retinopathy of Prematurity. A combination of good accredited qualifications, advanced training at the best centers in ophthalmology, large surgical experience and dedication to ethical practice puts him in the category of one of the most qualified surgeons in his field. He is currently the Chief Consultant and Head of Department of Vitreo-Retina at K.B. Haji Bachooali Charitable Ophthalmic and E.N.T. Hospital, Mumbai.

Sarvesh Tiwari is a Vitreo-retina surgeon practicing in Mumbai, India. He completed his VR fellowship from the prestigious Aravind Eye Hospital in 2011 and has worked as a VR consultant in Aravind Eye Hospital, Pondicherry and Sankara Eye Hospital. In the last 16 years, he has performed more than 5000 retinal surgeries & lasers and he specializes in diabetic retinopathy, ROP, uveitis & macular diseases. He has a keen interest in teaching and research, and has mentored various students and budding retina fellows in the past, in addition to having various national and international publications to his credit. He is currently a Consultant in the department of Vitreo-Retina at K.B. Haji Bachooali Charitable Ophthalmic and E.N.T. Hospital, Mumbai.

Research Field

Neha Joshi: Uvea, Diabetic Retinopathy, Age-Related Macular Degeneration, Retinal Vascular Occlusion, Glaucoma.

Anand Subramanyam: Diabetic Retinopathy, Age-Related Macular Degeneration, Retinal Detachment, Uvea, Macular Hole, Retinopathy of Prematurity.

Sarvesh Tiwari: Tubercular Eye Disease, Uvea, Retinopathy of Prematurity, Retinal Detachment, Diabetic Retinopathy.