Original Article

Tele-ophthalmology in retinopathy of prematurity screening – A study from a referral government hospital

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Abstract

Objective: The aim was to assess the role of tele-ophthalmology in retinopathy of prematurity (ROP) screening and to identify the risk factors for ROP. **Design:** Prospective cohort study. **Setting:** Level 2 neonatal intensive care unit (NICU) at a Government Hospital in Davangere, Karnataka. **Subjects:** 381 babies born <32 completed weeks of gestation admitted in NICU during study period. **Methods:** Examination of the eyes was done by a trained technician using a Ret Cam digital imaging, designed by The Karnataka Internet assisted Diagnosis of ROP, Narayana Nethralaya under the National Rural Health Mission scheme. It was later interpreted by a trained ophthalmologist using the concept of teleopthalmology. Babies were followed up and screened once weekly up to 3 months of age. **Results:** The overall incidence of ROP in our study was 25.2%. 3.8% of babies had Stage 1 disease, 3.8% had Stage 2, 53.8% had Stage 3, and 38.4% had Stage 4 disease. 34.2% of the babies who received oxygen therapy developed ROP. Anemia and respiratory distress syndrome have shown to significantly increase the risk of developing ROP. Two babies with ROP underwent light amplification by stimulated emission of radiation treatment and one baby underwent supplementary treatment. **Conclusion:** The incidence of ROP among high risk babies is significant and tele-ophthalmology can play a significant role in timely screening of babies in the remotest parts of the country. Oxygen therapy, anemia and respiratory distress syndrome were found to be significant independent factors predicting the development of ROP.

Key words: *Low birth weight, Prematurity, Ret Cam digital imaging, Retinopathy of prematurity, Tele-ophthalmology*

Retinopathy of prematurity (ROP) is major cause of the preventable blindness in children in the developing and developed world despite currently available surgical treatment in late stages of the disease [1,2]. Formerly known as retrolental fibroplasia, ROP was originally described in the 1940s by Terry who first showed its association with premature birth [3]. It is a vasoproliferative retinopathy occurring mostly in premature babies and typically manifests 3-4 weeks after birth. Approximately, 10-20% of babies developing ROP lose their sight permanently if untreated. Although ablation treatments can reduce the incidence of blindness by 25% in infants with late-stage disease, the patients often still have poor visual acuity after treatment. Most of these incidences of blindness, however, were preventable if diagnosed and treated on time before retinal detachment took place.

With improved neonatal care and hence, improved survival of sick premature and very low birth weight babies, there has been a steady increase in the incidence of ROP [4]. A large number of premature births happen amongst the lower socio-economic group, especially those in the rural areas, due to malnutrition, anemia, lack of awareness and access to facilities. Further, awareness about the condition is extremely limited even among doctors. In almost all such rural locations, there are no systematic screening processes in place, and there is a shortage of ophthalmic surgeons who could treat the condition. All these factors make the detection and treatment rather uncommon.

The Karnataka Internet assisted Diagnosis of ROP (KIDROP), Narayana Nethralaya Postgraduate Institute's flagship Tele-ophthalmology Program initiated in 2010 in Davangere under the National Rural Health Mission scheme provides ROP screening for rural and semi-urban infants in hitherto unscreened centers using the backbone of tele-ophthalmology and wide-field-digital imaging devices.

We present the screening data for ROP at a district government hospital attached to a medical college in Davangere, Karnataka using this tele-ophthalmology.

METHODS

The present prospective study was conducted in a Level 2 neonatal intensive care unit (NICU) at a Government Hospital in Davangere, Karnataka between October 2012 and February 2014. Institutional Ethics Committee approval was obtained before starting the study. 381 preterm neonates

with gestational age <32 weeks, both inborn and outborn, admitted in NICU were recruited after taking written consent from the parents. Gestational age was calculated according to new Ballard scoring system [5], last menstrual period and antenatal ultrasonography. Relevant patient data (sex, birth weight, gestational age, risk factors, ROP status, and staging) was entered in a pretested proforma. Investigations like sepsis screen, arterial blood gas analysis, echocardiography or other relevant investigations were done as and when required. For study purpose, small for date was defined as any baby whose weight was <3rd percentile for the gestation. Anemia was defined as a hematocrit of <40 and sepsis was defined as clinical and hematological evidence of sepsis (increased total leucocyte counts, absolute neutrophil count, c-reactive protein, or micro ESR).

All the recruited babies were screened for ROP once a week from the time of their recruitment and were followed up till 3 months of age. Mydriasis was achieved using 1% tropicamide [6]. The babies were examined with Ret-Cam digital imaging by a well-trained technician. The Ret-Cam digital imaging system enabled the capture of full color images of pediatric retina that could be used for immediate assessment of the retina and anterior chamber. Digital images were sent electronically to the ophthalmologist for immediate interpretation and tracked longitudinally over time [7]. ROP status was documented using the International Classification of ROP including stage, zone and extent of disease [8].

Analysis was performed and the results were presented as frequencies, percentages and relative risk. Chi-square test was used to assess the statistical significance of the association of the factors involved.

RESULTS

In our study, incidence of ROP was found to be 25.2%. Out of these, 3.8% had Stage 1 disease, 3.8% had Stage 2, 53.8% had Stage 3, and 38.4% had Stage 4 disease. 26.6% of males and 23.8% of females developed ROP. Babies weighing <1500 g showed a 17.6% incidence of ROP, while those weighing 1501-2000 g was found to be 9.5% and >2001 g was 8.6%. Most of the cases had similar stages of ROP in both eyes.

Anemia in babies was found to be a significant risk factor contributing to ROP as suggested by high relative risk (5.77). Anemia may predispose to ROP by producing tissue hypoxia. Respiratory distress syndrome (RDS) was found to be co-morbidity in neonates with ROP with 34.6% these babies developing ROP. In our study, association with other factors like hyperbilirubinemia (p = 0.87), apnea (p = 0.57) and sepsis (p =0.86) were found to be statistically insignificant (Table 1).

Only one baby had different stages of ROP in different eyes. Seven babies showed regression of initial stages of the disease and they were all found to regress from Stage 4 to Stage 3. Only two babies underwent light amplification by stimulated emission of radiation (LASER) treatment and one baby underwent supplementary treatment. Complications associated with treatment were minimal.

DISCUSSION

ROP is a vasoproliferative disorder occurring predominantly in premature infants. When normal vasculature of the developing retina is interrupted due to any injury/insult, neovascularization takes place after a latent period. However, if it is abnormal, then it leads to progressive retinopathy, resulting in retinal detachment and blindness. Various risk factors for ROP include prematurity, hyperoxia, hypoxia, hypercarbia, apnea, sepsis and blood transfusions [5,9-11].

The incidence of ROP in various western, as well as Indian studies, varies widely from 21 to 65.8% [10-18]. Of the 381 babies screened during study period, 25.2% had evidence of ROP. The incidence of ROP has shown a declining trend in our study as compared to previous Indian studies which could be attributed to better antenatal, obstetric and neonatal care programs, physician knowledge about ROP and most importantly availability of expert ophthalmologists through the use of tele-ophthalmology for screening programs. By this study, we were able to identify the role of tele-opthalmology in timely screening of tiny infants susceptible to ROP in remote areas where otherwise facilities for ROP screening is not available.

Previous studies have shown an inverse relationship between the incidence of ROP and gestational age and risk

Table 1: Risk factors for developing ROP

Risk factors	Number of cases	Number of cases with ROP	Relative risk	p value
Birth weight<1500 g	170	30	1.86	0.03
RDS	70	17	1.85	0.0062
Oxygen therapy	70	24	4.1	<0.0001
Hyperbilirubinemia	80	12	1.18	0.87
Sepsis	17	2	0.89	0.86
Anemia	10	10	5.77	<0.0001
Apnea	10	2	1.52	0.57

RDS: Respiratory distress syndrome

of ROP increases with decreasing gestational age [19]. Also, ROP was found to be more prevalent in children weighing <1500 g. In our study also, incidence of ROP decreased with increasing birth weight. In our study, babies who received oxygen therapy were found to be more prone to developing ROP. This is in accordance with western data [19]. However, the concentration and duration of exposure could not be assessed in this study.

Long-term follow-up of untreated babies has shown that the unfavorable outcome could be as high as 43-59%. In our study, only two babies underwent LASER treatment, and one baby underwent supplementary treatment. Only a small fraction of the patients received treatment which indicates that awareness about treatment is very poor. The need for a cost effective treatment scheme to reach out to all corners of the country is equally important as ROP is one of the leading causes of the preventable blindness.

While binocular indirect ophthalmoscopy (BIO) is currently the gold standard in ROP screening world-wide, it is perhaps only a matter of time before that is replaced by wide-field digital imaging. As more studies are being completed, wide-field digital photography is likely to replace BIO as the primary modality of screening for ROP. Studies have already shown that the Ret-Cam's telemedical screening program can detect all cases of treatment requiring ROP [20]. In addition, digital imaging requires significantly less time as compared to BIO and serves as a permanent document, which lends itself to scrutiny and review even in a medico-legal scenario [21].

These factors and more could influence the manner in which we would screen and manage ROP in the years to come with growing emphasis on digital imaging. We recommend the usage of tele-ophthalmology to reach out to the remotest corners of the country for early screening of susceptible babies. Like any other initiative, the measure of success of any program would be assessed by its sustainability and replicability. In the context of KIDROP, this would mean nationwide expansion to include every center that deals with premature births. This is a mammoth task and can be accomplished only with the collaboration of private hospitals, social entrepreneurs and government backup.

CONCLUSION

We successfully used tele-ophthalmolgy to screen the babies susceptible to develop ROP and RDS , oxygen administration and anemia were found to be significant risk factors. We recommend the use of tele-ophthalmology to reach out to the remote areas for early screening of susceptible babies. However, the feasibility of widespread use of this program should be assessed by further large scale studies.

CONTRIBUTIONS

Dr. Prarthna V Bhardwaj –Collecting old literature for comparisons with our own study; analysis and interpretation of data; in charge of writing the results and discussion; drafting the article. Dr. Gayathri H Aradhya – The in-charge of the NICU who was the pioneer of this pilot study for ROP in the Chigateri District hospital, Davangere; concept and design of the study; Supervision of the screening process every week; conclusion and revising of the article for intellectual content. Guarantor of the study. Dr Bharat Reddy – Obtaining informed oral consent from mothers for this study; in charge of collecting data including risk factors for all the 381 babies admitted to the NICU; collecting old literature for comparisons with our own study. Dr. AC Basavaraj – The head of the NICU who monitored our progress throughout our study and gave his valuable expertise on the same; final approval of the version to be published.

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