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Long Term Outcome of Primary Intraocular Lens Implantation in Children Operated before 2 Years of Age for Congenital Cataract

Dr. Jaspreet Sukhija, Dr. Gaurav Kumar, Dr. Jagat Ram, Dr. Ashish Sawhney

Primary IOL implantation in pediatric cataract has been the choice of surgical procedure since quite some time now.\textsuperscript{1-3} However the age at which IOL need to be implanted is still debatable when it comes to infants and toddlers. Risks associated with primary IOL implantation like an adult size IOL being implanted into small eye, postoperative inflammation and glaucoma do preclude one to implant an IOL in an infant’s eye.

MATERIALS AND METHODS

The records of all children less than 2 years who were operated between 2000 to 2002 were analysed. Eighteen children (33 eyes) who had a minimum follow up of 8 years were included. The rest had very short follow up or were lost to follow up or had other structural anomalies like microphthalmia, persistant hyperplastic primary vitreous, coloboma or history of trauma. All eyes underwent primary posterior capsulotomy with anterior vitrectomy and primary IOL implantation. Only eyes with axial length of $\geq 17$ mm were considered for IOL implantation. Retinoscopy was first done after surgery at an interval of two weeks when no inflammation was documented. Best corrected visual acuity was recorded at last follow up. Intraocular pressure was measured with goldmann applanation tonometer. Axial length was recorded at 8 years follow-up.

RESULTS

Thirty three eyes of eighteen children met the inclusion criteria. Fifteen cases had bilateral surgery and three had unilateral cataract. Follow up ranged from 96 months to 108 months. Average age at surgery was 14.4 months.

Refractive error: Post-op retinoscopy ranged from +7 dioptres to -2.5 dioptres with average being 2.03 dioptres. Refractive error at last follow up ranged from +6.5 dioptres to -11 dioptres with average being - 0.88 dioptres.
Visual Acuity: Final best corrected visual acuity was 6/18 or more in 24 eyes. 80% of them achieved 6/12 or better.

Axial length: Average preoperative axial length was 20.8 mm. The average axial length at last follow up was 22.23 mm meaning a change of 1.43 mm.

Complications: Besides amblyopia which was managed by appropriate occlusion where required, only one eye had raised IOP of 32 mm Hg. Average IOP documented was 15.7 mm Hg at last follow up. Posterior capsule opacification was seen in two eyes for which surgical capsulotomy was performed.

DISCUSSION

Refined techniques and new generation IOL’s for pediatric cataract surgery have shifted the consensus towards implanting an IOL at an early age with decreased risk of complications. Major problem in pediatric cataract patients is non-compliance with contact lenses resulting in amblyopia. There however still remains a grey zone which makes primary IOL implantation in infants questionable. The outcome for primary IOL implantation in very young children is limited by long term studies. Gelbart et al showed that 60% infants achieved visual acuity of 6/18 with best results in those operated before 8 weeks age. Favourable visual outcome was associated with early correction of aphakia. Poor results in previous studies have been attributed to late presentation, improper surgical techniques, inadequate management of amblyopia coupled with aphakia. Thoumazet et al concluded that primary IOL implantation provides significantly better visual acuity than aphakic contact lens-corrected eyes after pediatric cataract surgery in infants. Our case series shows that reasonably good visual outcome is possible in more than 70% children.

Limited data is available on long term refractive status in very young children undergoing cataract surgery with primary IOL implantation. Plager et al showed a mean myopic shift of 4.6 diptres in children operated at age 2 or 3 years over a period of 6 years with mean rate of shift decreasing as the age increased. They also emphasised the fact that future myopic shift is unpredictable in young children. We observed a mean refractive shift of 2.91 diptres over a period of 8 years. The incidence of glaucoma was negligible in our study.

Our study shows a favourable long term outcome of primary IOL implantation in children who were operated before 2 years age. The importance lies in choosing an IOL power to aim for 3 to 4 dioptries hypermetropia in this age group, performing primary posterior capsular capsulorhexis with endocapular IOL implantation coupled with amblyopia management. However our study
is limited by fact that there could be selection bias, retrospective nature and no data on children who were lost to follow up. There is scope for prospective studies with more cases to answer the shortcomings in this study.

REFERENCES

Aggressive Posterior - ROP - Successfully Treated with Intravitreal Ranibizumab and Laser Photocoagulation

Dr. Ajay Dudani

Retinopathy of prematurity (ROP) is a disease that affects immature vasculature in the eyes of premature babies and is inversely related to gestation and birth weight. ROP has been divided into five stages. Aggressive posterior ROP (AP-ROP), sometimes referred to as Rush disease, is a rapidly progressive form of ROP. It is observed most commonly in zone I, but may also occur in posterior zone II. If untreated, it usually progresses to stage 5 ROP. The characteristic features of AP-ROP are its posterior location and prominence of plus disease.

ROP is emerging as a major cause of blindness, in developing countries. The incidence of ROP varies between 16-48% and 27-35% in infant weighing less than 1000g and 1500g respectively at birth. The incidence of ROP in neonatal intensive care units (NICUs) or referral to tertiary care hospital in India ranged from approximately 21 to 40%. The reasons this high prevalence rate can be higher rate of premature birth, lack of resources resulting in compromised
neonatal care, leading to higher rates of severe ROP not only in extremely premature infants but also in larger, more mature infants.

Vascular endothelial growth factor (VEGF) is an important oxygen-regulated factor and its overexpression plays an important role in pathogenesis of ROP. The development of ROP is largely dependent on VEGF. When an infant is born prematurely the relatively hyperoxic environment the baby is introduced to shuts down the production of VEGF. Retinal maturation is delayed. Subsequently, at a time when intraocular VEGF levels would normally be declining late in the third trimester of pregnancy, abnormally high levels of VEGF are seen due to large areas of avascular retina and associated tissue hypoxia. The availability of FDA-approved drugs for anti-VEGF treatment renders it possible to treat such eyes off-label. The rationale for this treatment approach is that VEGF promotes retinal vascularization. Available drugs include pegaptanib sodium (Macugen®) for partial blockage of VEGF-A, or drugs such as ranibizumab (LUCENTIS®; Novartis inc.) and bevacizumab (Avastin®), which cause complete blockage of VEGF-A.

The studies, Pan-VEGF Blockade for the Treatment of Retinopathy of Prematurity (BLOCK-ROP) and Bevacizumab Eliminates the Angiogenic Threat of Retinopathy of Prematurity (BEAT-ROP), have shown promise to potentially change the standard for treatment of ROP.

The purpose of BEAT-ROP was to determine whether injections into the vitreous of an anti-VEGF will reduce the incidence of blindness by suppressing the neovascular phase of ROP, compared to a control group receiving conventional laser therapy and to determine the safety and efficacy of intravitreal bevacizumab in the treatment of ROP. The result from BEAT-ROP showed significant efficacy of Intravitreal bevacizumab in treatment for zone-1 disease (P=0.003), in infants with stage 3+ retinopathy in comparisons with conventional laser therapy. Also, bevacizumab allowed continued vessel growth into the peripheral retina, whereas conventional laser therapy permanently destroyed vessels in the peripheral retina. Although question of right dose and safety of using intravitreal bevacizumab in this population still remains, nevertheless results of the BEAT-ROP trial suggest that intravitreal bevacizumab monotherapy to be far safer and more effective than conventional laser for treating retinopathy of prematurity. These finding suggest that bevacizumab and other anti-VEGF drugs may signify a real advancement in treating this disease.

We report results of a case series of preterm, extremely low-birth-weight infant, with zone-1, stage 3+ AP-ROP, treated successfully with intravitreous ranibizumab injection (LUCENTIS®; Novartis inc.), an anti-angiogenic, monoclonal antibody fragment, with strong binding to VEGF-A. A detailed
search and analysis of content in medical databases like Medline, EMBASE, etc., failed to reveal mention of any case study, illustrating treatment of ROP, with Intravitreal ranibizumab. Few recent studies have shown that bevacizumab may be an effective alternative in the management of ROP. Since ranibizumab is derived from the same parent murine antibody as bevacizumab but is much smaller than the parent molecule and has better tissue penetration, encouraged us for experimenting Intravitreal ranibizumab in combination with laser, for treatment of ROP.

Case Report

20 consecutive eyes of 10 preterm babies 5 boys and 5 girls, with gestational age range from 27 to 32 weeks and gestation weight in range of 940 gms to 1200 gms, presented with zone-1, stage-3 ROP with corneal haze, media hazy, and iris neovascularisation. The International Classification of Retinopathy of Prematurity Revisited was referred to define Zone I and to subdivide the severity of stage 3 into mild, moderate, or severe depending on the extent of extraretinal fibrovascular tissue infiltrating the vitreous. Subsequently infants with bilateral moderate or severe stage 3 ROP were included in study, excluding infants with any congenital systemic or ocular abnormality. Diagnosis of AP-ROP plus disease was confirmed. The tunica vasculosa lentis and hyaloid arteries were persistent.

All the eyes were treated with bilateral intravitreal injections of ranibizumab (0.3 mg/0.02 ml) and retinal laser photocoagulation. 10 babies (6 boys and 4 girls), received intravitreal injections of ranibizumab. After a period of 4-12 weeks laser photocoagulation was performed in the peripheral retina with the following settings: spot size 300 microns, duration of 20 milliseconds with 100 milliseconds repeat interval.

Considering the severity of disease and based on recent use of anti-VEGF as intravitreal injections for ocular diseases caused by neovascularisation especially wet age-related macular degeneration (US Food and Drug Administration approved for ranibizumab in June 2006), off label use of ranibizumab intravitreal injection was considered. Consequently it was decided that Intravitreal ranibizumab injections at a dose of 0.3 mg (60% of the normal adult dose) under sterile conditions would be administered through the nasal pars plana of each eye. The injections were administered using continuous cardiorespiratory monitor. A speculum for premature infants was placed between the lids. A drop of povidone-iodine (5%) ophthalmic solution was placed into the conjunctival sac for 1 minute (pre and post injection) with the excess removed by a sterile cotton tip applicator from the temporal lid margin. Toothed forceps was used to steady the eye as dose of ranibizumab (0.02mL [0.3mg]) was injected behind the lens, repeating same procedure
for the other eye. Post procedure, ophthalmic antibiotic drop Moxifloxacin (Vigamox®) was prescribed for both eyes to begin immediately for next 10 days at interval of 4 hrs. Indirect ophthalmoscopy was utilized to look for any injury to the lens, to determine the presence of adequate blood flow through the central retinal artery, and to identify any retinal tears or vitreous hemorrhage immediately after the injection.

Improvement was seen within 48 hours after procedure and within next 1 week following the injections, the AP-ROP disappeared. Extraretinal fibrovascular proliferation superior and inferior to the typical indentation toward the macula disappeared and retinal vessels continued their anterior growth into the previously avascular retina. Ophthalmic examinations revealed central and steady fixation without strabismus, round pupils could be fully dilated, clear corneas and lenses, and minimal or no myopia or anisometropia. No ocular complications, incidence of endophthalmitis or systemic thrombotic events, hypertension or gastrointestinal hemorrhages related to the Intravitreal ranibizumab injections were observed.

DISCUSSION

AP-ROP is an aggressive variant of ROP that has unique characteristics and can proliferate rapidly. Laser photocoagulation, is still considered as initial treatment but thermal injury to the long posterior ciliary arteries in the horizontal meridian may result in anterior segment ischemia, the most devastating complication of ablative laser for threshold ROP. The choice of ranibizumab in our case study was deliberate, in order to try and minimize the possibility of systemic complications. The molecular weight of ranibizumab is 48 kd (provide greater retinal penetration) with Intravitreal half-life of ~9 days and Binding affinity of 0.14 nM. The shorter half life of ~15 hours versus 20 days for bevacizumab, leads to reduced risk of systemic complications. In addition to this, Fc fragment of antibodies binds immune molecules such as complement factors but ranibizumab does not comprise Fc fragment, leading to a reduced risk of complement-mediated toxicity and eye inflammation. Similarly, the decision to give bilateral intravitreal injections was deliberate to avoid creating a case series of amblyopic eyes due to the unilateral visual deprivation caused by the inflammatory response, cataract, hemorrhage, or other complications after laser therapy.

Intravitreal injection of anti-VEGF agents in neonates offers potential advantages over laser treatment, as shown by BEAT-ROP study. These benefits include eliminating the direct effects of laser, which may include visual field loss secondary to retinal atrophy and myopia related to scleral weakening. Additionally, anti-VEGF therapy may offer a safer treatment option than blind external application of cryotherapy or laser photocoagulation in infants with
rigid pupils or media too opaque for adequate visualization of the retina. Intravitreal injection can also cause regression of the proliferative component of ROP, leading to absorption of hemorrhage and improved visualization for subsequent laser therapy, if needed.

In our case series, AP-ROP was successfully treated by ranibizumab and revealed the effectiveness of intravitreal injection of ranibizumab for treatment of severe stage 3 ROP in zone I. Appropriate controlled studies with long-term follow-up are warranted to determine the potential safety and benefit Anti-VEGF agent ranibizumab, which may potentially play an increasing role as primary and/or adjunctive therapy in the future as additional studies become available.

**REFERENCE**


Central Corneal Thickness after Bilateral Congenital Cataract Surgery: Randomized, Clinical Trial

Dr. Vaishali Abhaykumar Vasavada, Dr. (Mrs.) Mayuri B. Khamar, Dr. Sajani Kalpit Shah, Dr. Vasavada Abhaykumar Raghukant

Central corneal thickness (CCT) is reported to be higher in aphakic and pseudophakic children. Prevalence of glaucoma commonly after congenital cataract surgery varies from 1-32% Diagnosis of glaucoma in children depends primarily on IOP measurements. Studies have found that applanation pressure is likely to overestimate the true IOP values as CCT increases. Thus recognizing abnormal CCT is important in the management of pediatric pseudophakic and aphakic glaucoma. To the best of our knowledge, there is a paucity of literature evaluating longitudinal changes in CCT after congenital cataract surgery in eyes with and without IOL implantation. This prospective, randomized clinical trial evaluated longitudinal changes in CCT following congenital cataract surgery in eyes with and without IOL implantation.

MATERIALS AND METHODS

40 children with bilateral, congenital cataract surgery were recruited for the study. Patients were randomly assigned to one of two groups. IRB approved the study. Informed consent was obtained from the parents/guardians of all children. Group 1 (n=20 patients, 40 eyes) comprised patients in which no IOL implantation was performed, Group 2 (n=20 patients, 40 patients) comprised aphakic eyes. Examination under anesthesia (EUA) was performed for every
patient at every visit. Intraocular pressure (IOP) was measured with a Perkins handheld applanation tonometer. CCT was assessed by ultrasonic pachymetry. Single surgeon (ARV) performed all the surgeries under general anesthesia using a standardized surgical technique. The same technique was followed in aphakic and pseudophakic eyes except for IOL implantation. Anterior capsulorhexis followed by bimanual I/A was performed for all eyes through 1mm paracenteses incisions. Thereafter, manual posterior capsulorhexis was performed alongwith a bimanual limbal anterior vitrectomy. In Group 1, the main temporal single plane clear corneal incision was not fashioned. In Group 2, after an adequate vitrectomy, temporal single plane clear corneal incision (2.8mm) was created. EUA was performed at one month, and then every 3 months during the first year, and every 6 months thereafter until 2 years. Results were analyzed for CCT at 1 month, 1 and 2 years postoperatively. We also analyzed the percentage change in mean CCT at 1 month and 2 years over preoperative values.

RESULTS
There was no significant difference in the distribution of the type of cataract between groups. In both groups, CCT increased after cataract surgery. Postoperative CCT between the two groups at 1 month, 1 and 2 years was statistically significantly different. Mean CCT in aphakic eyes was thicker than pseudophakic eyes (Table 1). Further while evaluating CCT, the correlation coefficient between OD and OS was 0.73, 0.84, 0.66, and 0.76 preoperatively and at 1 month, 1 and 2 years respectively. The correlation was statistically significant at all the follow-up visits (P<0.001) percentage difference in mean CCT from the preoperative period to 1 month (OD: aphakia versus pseudophakia: median 7.28% versus 3.57% P <0.014 and OS: aphakia versus pseudophakia: median 9.17% Vs 6.49% P<0.014) and 2 years (OD: aphakia versus pseudophakia: median 16.13% versus 6.91% P <0.014 and OS: aphakia versus pseudophakia: median 20.50% Vs 8.35% P<0.004) postoperatively was statistically significant between the groups. The percentage difference in mean CCT from the preoperative period to 1 month and 2 years postoperatively was significantly more with the aphakic group as compared to the pseudophakic group (Table 1). None of the eyes in either group developed glaucoma.

DISCUSSION
Several authors have shown that corneas of pediatric aphakes/pseudophakes were significantly thicker when compared with reported values of normal adult and pediatric eyes. It is unknown if increased CCT predates cataract surgery or develops postoperatively. It has been suggested that surgical trauma to cornea during the first few months of life might impair the
regulatory mechanisms, interrupting normal corneal development. It is also suggested that the process that led to the formation of congenital cataract may affect the development of the cornea, resulting in increased CCT or increased susceptibility to subclinical edema. We found a difference in CCT between aphakic and pseudophakic eyes in which an IOL had been implanted primarily. In absence of any change in preoperative CCT between two groups and as contact lenses have not been used, it is difficult to justify the presence of thinner corneas in the pseudophakic group. IOP plays an important role in the evaluation of children with glaucoma or those at risk of incurring glaucoma. In conclusion, in our study, we observed a marked increase in CCT after pediatric cataract surgery. However, thicker corneas and a higher rate of change in CCT were observed in the aphakic eyes as compared with the pseudophakic eyes. Based on these findings, we believe that if IOP is increased in either aphakic or pseudophakic eyes, it would be prudent to measure CCT to aid in its accurate interpretation.

Table 1: Central corneal thickness at different time points between and within eyes aphakic and pseudophakic eyes

<table>
<thead>
<tr>
<th></th>
<th>Aphakia, N= 40 eyes</th>
<th>Pseudophakia, N= 40 eyes</th>
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<tbody>
<tr>
<td></td>
<td>Mean ± SD (µm)</td>
<td>Median (µm)</td>
</tr>
<tr>
<td>Preoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td>538.13 ± 60.74</td>
<td>553.83</td>
</tr>
<tr>
<td>OS</td>
<td>537.23 ± 68.35</td>
<td>548.17</td>
</tr>
<tr>
<td>‘P’ value*</td>
<td>0.74</td>
<td>0.14</td>
</tr>
<tr>
<td>Postoperative (1 month)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td>582.36 ± 72.42</td>
<td>608.50</td>
</tr>
<tr>
<td>OS</td>
<td>584.50 ± 79.03</td>
<td>625.67</td>
</tr>
<tr>
<td>‘P’ value*</td>
<td>0.22</td>
<td>0.09</td>
</tr>
<tr>
<td>Postoperative (1 year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td>606.20 ± 68.12</td>
<td>624.67</td>
</tr>
<tr>
<td>OS</td>
<td>609.80 ± 76.18</td>
<td>610.33</td>
</tr>
<tr>
<td>‘P’ value*</td>
<td>0.50</td>
<td>0.18</td>
</tr>
<tr>
<td>Postoperative (2 years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td>627.00 ± 63.09</td>
<td>644.83</td>
</tr>
<tr>
<td>OS</td>
<td>627.23 ± 65.16</td>
<td>621.83</td>
</tr>
<tr>
<td>‘P’ value*</td>
<td>0.94</td>
<td>0.09</td>
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Laser in Situ Keratomileusis in Anisometropic Amblyopia in Pediatric Patients - An Indian Experience

Dr. Shrutika Kankaria, Dr. Prakash Kankaria, Dr. Vardhaman Kankaria

Traditional methods to correct and rehabilitate the refractive status of children with anisometropic amblyopia include spectacles and contact lenses combined with some form of occlusion or optical penalization therapy. However, a subset of these children may not improve with these traditional forms of treatment because of aniseikonia, compliance issues, or both. More over anisometropic amblyopia can be recalcitrant if refractive correction is not used. Witnessing the impressive success of modern refractive surgery in adults, a few ophthalmologists started investigating modern refractive surgery in the pediatric population in the 1990s. The first report of laser-assisted refractive surgery in the pediatric population was published in 1995. Since then, many small case series have been published reporting mild to moderate improvements in VA and stable refractive results in the short-term and inter- mediate-term follow-up. The results of myopic PRK in pediatric eyes with amblyopia resulting from anisometropia are good. We report a study of laser in situ keratomileusis (LASIK) to correct unilateral myopia in children.

MATERIALS AND METHODS

Study Design: It was a retrospective non comparative interventional case series. Forty eyes that had LASIK for uniocular moderate to high myopia were retrospectively analyzed.

Setting: Department of Refractive surgery, Sai Surya Eye Care private limited (Research and training), Maharashtra, India.

Inclusion Criteria: Patients had LASIK only if the refractive error difference between their eyes was more than 3.0D, non compliant to spectacles, non compliant and/or non tolerant to contact lenses. Only cases with minimum follow up of 6 months were included in the study.

Exclusion Criteria: Previous intraocular surgery, other associated posterior segment pathology, active inflammation, infection, corneal scarring, pachymetry value less than 500 microns, keratoconus, intraocular pressure (IOP) greater than 19 mm Hg, and a Schirmer test of less than 5.0 mm. To avoid inducing excessive aberration, patients requiring corrections that would result in keratometry readings under 30.0 D or over 50.0 D were excluded.

Preoperative evaluation: Best corrected visual acuity (BCVA), cycloplegic refraction, anterior segment evaluation, by slit lamp microscopy measurement...
of the corneal diameter, Schirmer test, corneal topography, pachymetry, IOP evaluation by noncontact tonometry, and a detailed fundus evaluation by indirect ophthalmoscopy, stereoacuity. Parents were told clearly that this form of therapy is not done for improving BCVA.

**Operative Procedure:** Informed consent was taken from Parents. Laser fluence was checked before each procedure as per guidelines. Surgery was done under topical anesthesia with proparacaine drops. After local preparation of both eyes with povidone-iodine 10% solution, the operative eye was draped. Speculum was placed between the lids of the operative eye. The peripheral corneal epithelium was marked with a gentian violet marker to help align the flap at the end of the procedure. A microkeratome (Rondo microkratome) was used to create a nasally hinged corneal flap with an intended thickness of not more than approximately 130 microns. A 6.0 mm optical zone was used for myopic corrections. All patients were awake and fixating during the procedure. Allegretto wavefront excimer laser was used in all the procedures. After the ablation, the corneal flap and stromal bed were irrigated with a balanced salt solution and the flap was replaced in its original position. The interface was gently irrigated to remove debris. The flap was left undisturbed for 3 minutes. The lid speculum and drape was removed. A plastic shield was placed over the operated eye. Patient was examined again after 10 minutes for confirming flap position and alignment under the slitlamp microscope. It was a single surgeon study.

**Ambyopia therapy:** All the patients were asked to do part time occlusion of dominant eye irrespective of their age.

**Follow up Schedule:** The patients were reviewed 1 day, 1 week, and 1, 3 and 6 post-operatively. The follow-up examinations included BCVA, refraction, stereoacuity, detailed anterior segment evaluation, corneal topography, and a detailed fundus evaluation.

**RESULTS**

All patients tolerated procedure well. Total 40 eyes which underwent LASIK for moderate to high anisomyopia were analysed. There were 14 male and 26 female patients. Mean age at presentation was 7.6 years (Range 5.5 – 9.5 years). All patients were followed for at least 6 months. After surgery Mean follow up was 13 months (Range 7 months – 18 months). The mean preoperative BCVA in decimal equivalent was 0.3155 (range 0.17 to 0.5). At 6 months, the mean BCVA was 0.3525 (range 0.25 -0.5). The safety index (mean postoperative BCVA/mean preoperative BCVA) was 1.12. The mean preoperative spherical equivalent (SE) was -8.475D. (Range -6.00 to -12.00D). Mean post operative spherical equivalent was -0.975D (Range 0 to -2.00). Mean correction achieved by excimer laser was
-7.5D. Statistical analysis showed the refractive error decreased significantly after LASIK. Twelve patients gained one line BCVA and none lost any line on Snellens. There were no flap related complications. Three patients developed mild haze which disappeared at 3 months follow up. The reason for the haze is unknown. None of the eyes developed an IOP increase or a retinal complication.

**DISCUSSION**

Spectacle correction and contact lenses have been popular modes of correction to treat myopia in children. Anisometropia is a leading cause of amblyopia and occurs because of unequal refractive error between the two eyes. In cases of uniocular high myopia, if the refractive error is more than 3.0 D, a high incidence of intolerance is seen with spectacle because of dissimilar image size and optical aberrations. Contact lenses do not minify images, do not have optical aberration. But some children become contact lens intolerant and have problems maintaining them. These cases develop anisometropic amblyopia if left uncorrected. Conventional amblyopia therapy includes occlusion, to which all children are not compliant especially in Indian settings. Photorefractive keratectomy offers promising results in selected patients with uniocular high refractive errors. LASEK and LASIK procedures have also showed comparable results and good outcome at intermediate follow up in anisometric paediatric population. LASIK can be more advantageous over PRK and LASEK as it preserves Bowman’s layer with less possibility of haze and regression.

There are some problems in conducting general anesthesia in refractive surgery. Laser operating room is not equipped with an anesthesia machine or monitors for monitoring vital signs of patients during the procedure. Achieving and maintaining patients airway is difficult due to position of microscope and eye tracker. Cook and coauthors reported leak of anesthetic gases into the laser environment can cause the laser malfunction. This is because the wavelength of the argon–fluoride excimer beam (193 nm) is within the absorption spectrum of anesthetic gases such as nitrous oxide. If nitrous oxide escapes into the path of the excimer beam, attenuation of the beam will occur. The laser will attempt to increase voltage to maintain fluence, but if treatment time is prolonged, the laser will stop firing and an error message, such as fluence out of range, will appear. This would result in cancellation of further cases. Topical anesthesia is used in adults having refractive surgery because it allows the patient to self-fixate, reducing the likelihood of decentered corneal ablation. These were our reasons for choosing topical anaesthesia. It was discussed in details with all the parents. All patients were neurologically sound and were co-operative during procedure and follow ups. There was not a single case of decentred ablation in our series as all patients were self fixating.
Refractive surgery has been seen to be safe in well selected paediatric patients. The haze was rarely severe to cause decrease in BCVA. Only one study reported 2 incidents of free flap during LASIK. They were managed well. So, Severe complications were seen to be rare. There were no flap related complications. Three patients had mild interface haze which resolved at 3 months follow up. Twelve patients gained 1 line BCVA on Snellens chart and all others maintained their preoperative BCVA. None of the patients in our series lost a single line of BCVA over mean follow up of 13 months. Thus LASIK was seen to be safe in this short term study.

In conclusion outcomes of LASIK for anisometric amblyopia in paediatric patients are encouraging. A large prospective study is required to determine long term results.

REFERENCES

Clinical Spectrum of Congenital Corneal Anesthesia: Our Experience at A Tertiary Eye Care Center

Dr. Muralidhar Ramappa, Dr. Sunita Chaurasia, Dr. Devaprasad

Congenital corneal anesthesia (CCA) is a rare clinical entity that is characterized by sensory deficit that may be confined to the cornea, or extend to other divisions of the trigeminal nerve. Sensory deficit may occur as an isolated abnormality, as part of a complex neurological syndrome, or it may occur in association with multiple somatic abnormalities and congenital insensitivity to pain. Often poses a diagnostic dilemma, particularly in the pediatric age group.

To describe the clinical spectrum of patients diagnosed with congenital corneal anesthesia.

Retrospective, interventional study of 40 patients diagnosed with corneal insensitivity syndrome between January 2006 and Dec 2010. Medical records were analyzed for clinical features, birth history, management modalities and outcomes.

The diagnosis of corneal anesthesia was made based upon the clinical history and examination findings. Pediatrician/ Neuro-physician consultation was sought wherever there was any evidence of systemic involvement.

RESULTS

Out of 40 patients, 26(65%) were males and 14(35%) were females. Mean age at presentation was 33.3 ± 11.2 months. Twenty three (57.5%) patients had bilateral involvement. The demographic data is presented in Table 1.

Clinical features: Initial symptoms (as noted by parents/guardians) were redness in 15 patients, white spot in 36 patients. Twenty one patients had associated photophobia. The clinical information is summarized in Table 2a and 2b.

Table 1: Demographic data

<table>
<thead>
<tr>
<th>Parameters</th>
<th></th>
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<tbody>
<tr>
<td>Age(days)</td>
<td>Mean 33.3± 11.1</td>
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<tr>
<td></td>
<td>Range 1 month to 16 years</td>
</tr>
<tr>
<td>Gender</td>
<td>Males: 26 (65%)</td>
</tr>
<tr>
<td></td>
<td>Females: 14(35%)</td>
</tr>
<tr>
<td>Laterality</td>
<td>Right eye: 8(20 %)</td>
</tr>
<tr>
<td></td>
<td>Left eye: 9(22.5%)</td>
</tr>
<tr>
<td></td>
<td>Both eyes: 23(57.5%)</td>
</tr>
</tbody>
</table>
### Table 2a: Clinical information: history, symptomatology and diagnosis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Number of patients/eyes</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration between onset of symptoms and presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean 25.27 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range 1 day - 7 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤7 days</td>
<td>10 patients</td>
<td>25%</td>
</tr>
<tr>
<td>7-14 days</td>
<td>12 patients</td>
<td>30%</td>
</tr>
<tr>
<td>≥14 days</td>
<td>18 patients</td>
<td>45%</td>
</tr>
<tr>
<td>Duration between presentation at the clinic and identifying the diagnosis of Corneal anesthesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean 0.75 days (Range 0- 10 days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosed at first visit</td>
<td>30 patients</td>
<td>75%</td>
</tr>
<tr>
<td>Diagnosed within 3 days</td>
<td>7 patients</td>
<td>17.5%</td>
</tr>
<tr>
<td>Diagnosed between 3-10 days from first visit</td>
<td>3 patients</td>
<td>7.5%</td>
</tr>
<tr>
<td>Initial impression made as microbial keratitis</td>
<td>10 patients</td>
<td>25%</td>
</tr>
<tr>
<td>History of absence of tearing (as told by parents)</td>
<td>—</td>
<td>25%</td>
</tr>
<tr>
<td>Symptoms at the onset of disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redness</td>
<td>15 patients</td>
<td>37.5%</td>
</tr>
<tr>
<td>White spot (in either eye)</td>
<td>36 patients</td>
<td>90%</td>
</tr>
<tr>
<td>Photophobia</td>
<td>21 patients</td>
<td>52.5%</td>
</tr>
<tr>
<td>History of parental consanguinity</td>
<td>—</td>
<td>30%</td>
</tr>
</tbody>
</table>

### Table 2b: Clinical information: Clinical signs and co-morbidities

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Number of patients/eyes</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical signs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. OCULAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent corneal sensations</td>
<td>ALL eyes 63 eyes of 40 patients</td>
<td>100%</td>
</tr>
<tr>
<td>Absent adnexal ± facial sensations</td>
<td>10/40 patients</td>
<td>25%</td>
</tr>
<tr>
<td>Low Schirmer’s values (tested in 10 patients)</td>
<td>10/40 patients</td>
<td>25%</td>
</tr>
<tr>
<td>Blepharospasm</td>
<td>21/40 patients</td>
<td>52.5%</td>
</tr>
<tr>
<td>Epithelial defect</td>
<td>23/63 eyes</td>
<td>36.5%</td>
</tr>
<tr>
<td>Sterile infiltrate Vascularization</td>
<td>9/63 eyes</td>
<td>14.2%</td>
</tr>
<tr>
<td>II. SYSTEMIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalized anesthesia</td>
<td>6/40 patients</td>
<td>15%</td>
</tr>
<tr>
<td>Self mutilation behavior/Skin ulcers</td>
<td>10/40 patients</td>
<td>25%</td>
</tr>
<tr>
<td>Co- morbid conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ocular: (Ptosis, congenital VII Nerve palsy)</td>
<td>2/40 patients</td>
<td>5%</td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>1/40 patients</td>
<td>2.5%</td>
</tr>
<tr>
<td>Delayed milestones</td>
<td>8/40 patients</td>
<td>20%</td>
</tr>
</tbody>
</table>
Microbiological Results: Smears-No organisms detected and Cultures -sterile in all.

Management

Medical:
- Initial treatment with antibiotics: 33 eyes
- Artificial tear supplements: all eyes

Tarsorrhapy: all eyes
Repeat tarsorrhaphies due to failed tarsorrhaphy: 4 eyes
Tissue adhesive + Bandage Contact lens: 3 eyes
Subsequent intervention (DALK): 2 eyes
Penetrating keratoplasty: 1 eye

Outcomes and clinical course
Mean duration for resolution of infiltrate following tarsorrhaphy: 30 days
Corneal Scar: 55/80 eyes (68.75%)
Outcomes of keratoplasty: Failed grafts in all
Clinical course after tarsorrhaphy: Stable in all eyes.

DISCUSSION

Early diagnosis of congenital corneal anesthesia is challenging and it is often missed/delayed due rarity of the disease. Often the entity is treated with intensive antibiotic therapy as it mimics microbial keratitis. Detailed history and meticulous examination help in making an accurate diagnosis. History of absence of tearing, examining for corneal sensations and performing Schirmer’s test in cooperative patients are simple means of accurately diagnosing the clinical condition in the early stages of presentation. At present, as there is no curative treatment available for the condition permanent tarsorrhaphy is the most effective strategy in maintaining the integrity of the epithelium.

Emphasis needs to be laid on a comprehensive eye examination by a pediatrician in conjunction with the expertise of a pediatric ophthalmologist to diagnose the condition before the stage when parents bring the child to the clinic with epithelial problem.

REFERENCES

Educational Impact of Service in Children with Low Vision Towards Mainstreaming

Dr. Tanuja Britto, Dr. Rajamohan M., Dr. Nelson Jesudasan

The goal of all low vision intervention in children is to integrate them into mainstream schools. Irregular follow-up of low vision clients is often a deterrent to improving quality of life. In the present study, an attempt has been made to evaluate the effectiveness of low vision intervention and regular follow up on the quality of life especially in the education of children with low vision, over a period of 5 years.

MATERIALS AND METHODS

All the children seen from 2006 to 2007, who underwent a thorough clinical/educational assessment and prescribed interventions, were enrolled in the study and were followed up over five years. The subjective and objective improvement seen over the years was evaluated, to assess quality of life improvement. The former was done with a questionnaire to the child, parents and teachers and the latter by clinical and functional assessment. Comparative data collected included aetiology, causes of low vision, presenting and best acuities, interventions and improvement in educational performance. Improvement in school performance was assessed by evaluating reading, writing and blackboard copying comfort, social communication and participation in extra curricular activities.

RESULTS

Of the 124 cases enrolled in 2006 and 2007, 61 patients were finally reviewed in 2011. Of these 30 were males (49%) and 31 were females (51%), with 4(6.5%) in 6 – 10 years, 28(46.1%) in 11 – 15 years, 24(39.3%) in 16 – 20 years and 5(8.1%) in > 20 years of age. Aetiology of low vision was refractive error / amblyopia in 46%, retinal causes in 20% and idiopathic nystagmus in 12%.

Clinical outcome was evaluated by presenting acuities with use of distance glasses and devices. Functional vision outcome was seen by help needed with reading, writing, ability to read the size of text of school book/ at work, accessing information on blackboard and participation in play/sports. Average presenting distance vision was 6/45 at initial presentation, while at follow-up it was 6/24. Presenting near vision acuity was 1M (N8), while best corrected was 0.63M (N5). 86% were prescribed new glasses and 31.1% needed magnification.

75% continued their education in schools while 13% had moved on to employment. Only 12% were school dropouts. 56% reported that glasses and devices helped in school work. The learning medium was print in 97%.
76% could read the required size of school text and 36% needed less help with reading. Written work was legible in 76% and 43% needed less help with writing after intervention. 58% could read blackboard independently. 51% did not need any extra help compared to peers in class work. 71% participated in games, 45% participated in outdoor sports more often now than before. 90% were confident in social communication and 52% reported confident mobility in unknown places.

DISCUSSION

Overall educational improvement was seen in 48.38% and quality of life improvement was seen in 63.8% of cases. The changes in educational performance was similar to those for children with low vision in high income countries. Although the average vision level of children was better than at initial assessment it was not as good as it could be. The reported functional vision changes still need further analysis as school work gets more difficult over the years. Other factors that contribute to clinical and functional vision changes, which need further investigation are quality of teaching, size of class, attitude towards learning/ reading in family, academic interest of child, peer support and quality of information on visual needs given to school, carer, client. In addition, the success of clinical low vision service and visual acuity improvement depends on regular follow up as children may need new glasses every year.

It can be concluded from the study that regular follow up and periodic intervention is necessary in children with low vision to ensure educational improvement.

REFERENCES

A 2.5 year young female girl was admitted at the emergency room with complaints of gradual worsening headache associated with nausea. The child also had lethargy, reduction of consciousness level. ENT evaluation was not productive for any deficit as the child was in altered sensorium. Ophthalmic examination show inferotemporal branch retinal artery obstruction in one eye. This finding was crucial to the diagnosis of Susac syndrome. This is a rare autoimmune disease characterized by endotheliopathy of retina, encephalic tissue and cochlea. MRI of the brain also showed typical features. Thorough blood investigation did not reveal any abnormality. Pt was treated with pulse steroids to prevent her from developing severe sequel of this syndrome. The child showed dramatic improvement in her systemic condition within 48 hours of starting the treatment. Three days later repeat ENT evaluation revealed bilateral hypoacusis.

Digital fundus Fluorescein angiography confirmed the inferotemporal branch retinal artery occlusion in the right eye. The MRI scan showed T2 weighted high signal discrete areas around the periventricular region in the white and grey matter and corpus callosum. An audiogram was not possible due to patient uncooperation.

The lumbar puncture showed a marginally raised cerebrospinal fluid, with no increase in cell count. Erythrocyte sedimentation rate was 12 mm. She was treated with intravenous prednisolone 1g/kg for 3 days. The response to steroid was remarkable with the patient’s mental status improved dramatically. The symptoms of encephalopathy subsided within 48 hours. She was started on oral steroid of 20mg/day after that, which was tapered after 15 days. The MRI was repeated after 4 weeks and the hyper intense areas had almost disappeared.

**Comment**

Susac syndrome was first described independently by Susac in 1976 and since then called by different names like RED-M (retinopathy, encephalopathy, deafness associated with microangiopathy), SICRET (small infarction of cochlear, retinal and encephalitic tissue) or retinocochlear vasculopathy. This syndrome almost commonly affects women in the 20–40 years age group and is characterised by the clinical triad of encephalopathy, branch retinal artery occlusion and sensorineural hearing loss due to microangiopathy of retina, brain and cochlea. Headache is the usual prodromal symptom. The condition has a chronic relapsing course punctuated by frequent remissions.
and exacerbations. It is a self-limiting disorder, extending over 1–2 years with remission.

Our case is the youngest reported in the world and the first ever case report from India. The underlying process is believed to be an immunological reaction, leading to small vessel vasculitis causing micro infarcts in the retina, brain and the apical turn of the cochlea. The important differentials would be multiple sclerosis, aseptic meningitis, systemic lupus erythematosus, Bechet’s and complicated migraines. The other vasculitides like sarcoidosis, tuberculosis, syphilis and lymphomas have to be ruled out.

A high index of suspicion, leading to early recognition of this syndrome is important because treatment with immunosuppression may minimise permanent cognitive, audiologic and visual sequelae. This syndrome has a good prognosis when treated early. In patients whom early diagnosis has led to early administration of immunosuppressive therapy, recovery can be almost complete.

Correlation of Macular Thickness, Multifocal ERG with Visual Acuity in Oculocutaneous Albinism (OCA)

Dr. Jitendra Jethani, Dr. Monika Lalwani, Dr. Sugnesh Parmar, Dr. Jayprakash Purohit

Visual abnormalities associated with ocular albinism include reduced visual acuity, nystagmus, and hypersensitivity to light (photophobia). The cause of poor vision may be foveal hypoplasia, nystagmus, photophobia and abnormal decussation of the nerve fibres at optic chiasm. Electroretinogram (ERG) have been shown to be normal in such patients. Optical coherence tomography (OCT) shows thickened fovea and increased macular thickness. The function of such hypoplastic fovea (also called fovea plana in isolated cases) has been evaluated by multifocal ERG (mfERG). The reports have been suggestive of reduced function (amplitude) in the macular region. We did a study to evaluate the correlation of visual acuity with the thickening of fovea evaluated by OCT and function of thickened fovea evaluated with mf ERG.

MATERIALS AND METHODS

A total of 10 patients were selected for the study with oculocutaneous albinism. All the patients had features of ocular albinism viz. albinoid fundi tessellation,
foveal hypoplasia, iris transillumination defects. All the patients underwent OCT (OCT stratus III, Zeiss Meditec, Dublin, CA, USA). Foveal hypoplasia was evaluated using a fast macular cross-hair Stratus OCT scan with pupils dilated. To minimize test errors resulting from nystagmus or poor fixation, measurements by a skilled technician were replicated and only those images with good fixation and signal strength of more than 7 were selected. Multifocal ERGs (Roland Consult, Germany) were recorded to map the topography of retinal function in the central retina. The stimulus array consisted of 103 hexagons that were modulated between black and white in a pseudo-random sequence called an m-sequence. The average amplitude of central ring was taken into consideration and was matched with the outer rings.

RESULTS

A total of 10 patients (20 eyes) were included in the study. The mean age of the patients was 16.1 +/- 7.3 years. The patients were divided into three groups based on their visual acuity into more than 6/12, between 6/18-6/24, and 6/36 or less. Mean macular thickness (MT) in eyes with visual acuity more than 6/12 (n=6) as 194.8 +/- 26.7 microns, vision between 6/18-6/24 (n=10) was 220 +/- 12.3 microns and eyes with visual acuity 6/36 or less (n=4) was 243.5 +/- 17.3 microns.

To compare whether the difference in macular thickness with respect to the visual acuity was statistically significant or not we found that the group with visual acuity more than or equal to 6/12 with vision 6/36 or less, p value was 0.01. On comparison of macular thickness in vision between 6/18-6/24 and vision more than 6/12 p value was 0.02 and p value was 0.01 on comparing groups with vision between 6/18 -6/24 with vision less than or equal to 6/36 was 0.01. The macular thickness obviously is related with visual acuity as has been described by previous authors like Seo et al and Thomas et al.

On evaluating the amplitude of ring 1 in the mfERG the P1 (the first positive wave) and N1 (the first negative wave) in patients with visual acuity more than or equal to 6/12 was 1.1 +/- 0.5 microvolts for P1 and for N1 the amplitude was 0.7 +/- 0.2 microvolts, for vision between 6/18-6/24 the amplitude for P1 was 0.6 +/- 0.5 microvolts and for N1 was 0.3 +/- 0.2 microvolts and for visual acuity less than or equal to 6/36 vision the amplitude for P1 and N1 was 0.7 +/- 0.2 microvolts and 0.3 +/- 0.1 microvolts respectively. On comparing the groups with visual acuity 6/12 or better with vision between 6/18-6/24 the p value was 0.01 and on comparing > 6/12 with < 6/36 the p value was 0.02 for amplitude of P1. However, on comparing groups for amplitude of P1 between visual acuity < 6/36 with vision between 6/18-6/24 was 0.9.

A similar comparison for amplitude of N1 was done between the three groups. The p value on comparing > 6/12 with < 6/36 was 0.013, between > 6/12 with
6/18-6/24 group was 0.02 and p value for comparison between < 6/36 and 6/18-6/24 group was 0.01. All the comparison showed a significant p value which suggests that the visual acuity and amplitude of these potentials is related to each other.

DISCUSSION

The visual acuity in OCA has been compared mainly with the macular thickness (MT). A few authors have found out the retinal function in foveal hypoplasia associated with or without OCA. Further, some authors have actually mentioned that foveal hypoplasia should actually be called fovea aplana since the retinal function is actually preserved in isolated foveal aplasia. OCA patients apart from having the increased foveal thickness do have other ocular problems like iris transillumination defects, reduced choroidal pigmentation and abnormal decussation of fibres at the level of optic chiasm which may influence the visual acuity. Therefore a direct comparison of isolated foveal aplasia or cone achromatopsia (may have increased foveal thickening) would be erroneous.

A direct comparison of visual acuity with foveal thickness does show that poor visual acuity groups have statistically significant thickening of foveal region. This has been suggested by Seo et al and Thomas et al. Since we restricted our study mainly to compare the visual acuity with the thickening of fovea and to compare this with the mf ERG we did not further staged the fovea as suggested by Thomas et al who used spectral domain OCT to classify these changes.

The mf ERG also shows that there is reduction in the amplitude of N1 when the visual acuity is poor. However, the two groups with visual acuity less than 6/12, did not show much difference in the reduction of amplitude once the visual acuity was less than 6/12. This variation could be because of small sample size or may represent a true cutoff at the level of 6/12. Nusinowitz et al evaluated the retinal function in albino patients. They suggested that the central retinal function measured with the mERG had a flatter response topography with depressed macular function compared to normal controls. They did not compare it with the visual acuity as they felt that the mf ERGs recorded in these patients should be evaluated cautiously because of the presence of nystagmus. Eye movements of any kind introduce a level of blur in the retinal image that will be variable and dependent on the extent of the eye movement.

As there are currently no available methods to ensure stabilization of the mf ERG stimulus on the retina, or to modify local measurements by the severity of the nystagmus to increase the accuracy of the mf ERG recordings. The nystagmus certainly increases the level of “noise” in the recordings we
believe that a comparison of visual acuity macular thickness should be done with electric potentials to get a true picture of central macular function in these patients. The potentials may be reduced when compared to normal but comparison here was done amongst the OCA patients and that would be valid with visual acuity difference.

In conclusion macular thickness in OCA patients affects the visual acuity. Thicker foveas may have reduced vision. The amplitude of central macular function may be reduced with reduced visual acuity especially the N1 waveform. Importantly the P1 waveforms shows a reduction in amplitude with visual acuity but once the visual acuity loss is severe the amplitude doesn’t reduce further.

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**Flash Visual Evoked Potentials in Patients with Periventricular Leucomalacia (PVL) in Children Less Than 1 Year of Age**

Dr. Jitendra Jethani, Dr. Monika Jethani

Premature birth, asphyxia, infections during pregnancy, and birth trauma are predisposing factors for brain damage. The most prevalent form of brain injury in preterm infants is due to white matter lesions categorized as periventricular leucomalacia.1-3 Periventricular leukomalacia (PVL) is a major cause of motor and cognitive impairment in preterm infants, and may also be associated with epilepsy and visual impairments in later life.4-5 Recent improvements in the survival rate of extremely premature infants have resulted in an increasing incidence of neurological sequelae. This is partly attributable to an increase in infants with PVL.4 Okumura et al reported that PVL was observed in 80% of preterm infants with cerebral palsy.6 Apart from visual loss the children with PVL may suffer from strabismus, amblyopia, nystagmus, visual field defects, delayed visual maturation and increased cup disc ratio.5,7 In our own previous study on children with PVL, we found that around 81.6% children had associated strabismus. Fourteen (36.8%) children had nystagmus.7 It has been controversial whether electrophysiology offers better precision than behavioural techniques in measuring visual acuity in children with brain damage.8-14 The visual response has been evaluated with Forced preferential (FP) looking test8,10,12,14 or with visual evoked potentials (VEP) (flash8,10,12 or sweep8,10,12,14). In the flash VEP (fVEP) the evaluation has been on the N300 in the preterm infants for the predictive value of their visual function.3,4,11
We did a study to evaluate the fVEP responses in preterm children with PVL under the age of 1 year and the changes in fVEP responses at various stimulation frequencies.

**MATERIALS AND METHODS**

A total of 9 preterm children with MRI diagnosed PVL changes were included in the study. The final diagnosis of PVL was made on the basis of clinical signs of cerebral palsy and MRI findings including loss of white matter volume, irregularities of the ventricular wall, and abnormal signal intensities in the periventricular white matter. Standard handheld VEP (Roland Consult, Germany). FVEPs were performed under sedation. Two or more trials were made to ensure reproducibility of the waveform. The single active electrode was placed at Oz, and the impedance was below 5 ohm. Flash light stimuli, using a hand held Ganzfield, were presented at a frequency of 1.4 Hz and this was followed by 8 Hz frequency. Fifty responses were averaged for each trial with a band-pass of 1 to 100 Hz. Responses with excessive artifacts were automatically rejected.

**RESULTS**

A total of 9 infants (18 eyes) were taken for the study. The mean age was 9.7 +/- 3.5 months (3-12 months). The averaged data for both the 1.4 Hz and 8 Hz frequency were evaluated. The mean latency of N1 and P1 on stimulation with 1.4 Hz was 47.9 +/- 15.2 ms and 77.7 +/- 26.0 ms respectively. The mean latency of N2, P2, N3, P3 was 108.6 +/- 32.8 ms, 143.3 +/- 36.9 ms, 179.4 +/- 41.8 ms and 211 +/- 44.6 ms respectively. The mean amplitude with the stimulation at 1.4 Hz N1-P1 was 5.1 +/- 4.5 mv.

On stimulation with 8 Hz frequency with the same hand held ganzfield, the mean latency of N1 and P1 was 189.8 +/- 25.6 and 238.4 +/- 33.6 ms. The mean amplitude with 8 Hz stimulation frequency was 5.59 +/- 3 microvolts.

There seems to be a severe delay in the latency of the N1 and P1 when stimulated at a higher frequency. The machine typically has these two inbuilt frequencies at which the light source is delivered for the VEP recording.

**DISCUSSION**

The ocular structures are healthy and the pupillary responses are brisk in children with periventricular leucomalacia. The ocular findings do not explain the child’s visual impairment. Flash VEP has been used to document the changes in these children. The sweep VEP has been done to predict the visual acuity and comparisons have been made with FP looking tests. Our findings indicate that once the frequency of stimulation is increased there is a delay in the latency of the waveforms. González-Frankenberger et al.
Kidokoro et al. and Kato et al. did fVEP studies on preterm infants during first week of life. They have studied the N300 component and suggested that a latency delay of 330 ms would point significantly towards PVL changes. Kidokoro et al. studied the predictive values of a combination of EEG and FVEPs for the early diagnosis of PVL. They compared fVEP with EEG and found that fVEP were better for the diagnosis of PVL. Kato et al. presented similar findings and also showed a positive wave at 200 ms termed as P200 which was the first positive wave. Since the studies were done on neonates they mainly studied the N300 and presented the frequency at 0.2 Hz with duration of 10 sec. No such study in children under 1 year of age at increased frequency of stimulation has been done. Though our study shows that as the frequency increases from 1.4 Hz to 8 Hz the delay in latency is significant, we did not study this at various frequencies in steps. The increase in the frequency may make it a more sensitive tool once a particular critical frequency is determined which would require further studies to do fVEP at different frequencies of stimulation.

In conclusion we have found that the frequency of stimulation is important in determining the latency in children with periventricular leucomalacia in children under 1 year of age. The increase in frequency of stiumlation increases the latency though the amplitude is not changed much even at higher frequencies.

REFERENCES


