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Original Research Article

FACTORS AFFECTING VISUAL OUTCOME IN CHILDREN UNDERGOING CATARACT SURGERY

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ABSTRACT

Background: Pediatric cataract is a leading cause of childhood blindness. If is untreated it can lead to social, emotional and economical burden to their family and society. **Objective:** To study long term visual outcomes and binocular recovery in children undergoing cataract surgery and to determine the factors affecting visual acuity and stereopsis in children undergoing cataract surgery.
Materials and Methods: This Cross sectional observational study was conducted in Department of Ophthalmology, King George's Medical University (KGMU), Lucknow after getting approval from the institutional ethical committee. Informed written consent was taken from parent of each child for the study. Duration of study was One year.
Results: Mean distance visual acuity of 0.8 LogMAR and mean near stereopsis of 158 seconds of arc is achieved in the long term. The eventual visual outcomes are not related to delay in surgery or laterality of cataract. Better stereopsis is achieved in absence of ocular comorbidities. In children below 2 years of age myopic shift in faster in children left myopic initially than those left hypermetropic. Early surgery and moderate hypermetropia in the immediate postoperative period favour better long term stereopsis. Best visual acuity is achieved in presence of mild long term residual hypermetropia.
Conclusion: Early diagnosis and management of Pediatric Cataract may improve the visual outcomes. Screening of preschool children may help in early diagnosis
Keywords: Visual Outcome, Children, Cataract Surgery.

INTRODUCTION

Blindness related to pediatric cataract can be treated with early detection and appropriate management can be useful to overcome in blindness related to pediatric cataract. The incidence ranges from 1.8 to 3.6/10,000 per year and the median prevalence is about 1.03/10,000 children (0.32–22.9/10,000). Childhood cataract have higher prevalence in low-income economies (0.63–13.6/10,000) as compared to economies with high-income (0.42–2.05/10,000).[1] Some of the unilateral and numerous bilateral cataracts are idiopathic. There is no significant difference in the prevalence of cataract when prevalence is analyzed on basis of gender or laterality.[2] However, studies have revealed that during ante natal period, mother of these kids had a history of illness 67% cases and 22% had history of intake of few or other medications. Congenital cataracts frequently connected with visual irregularities in 27% of cases and with systemic abnormalities in 22% of cases. The finding of such cases is made after excluding different causes. In hereditary cataractsAutosomal-dominant cataracts with incomplete inheritance are most common.[3] Cataract is a common finding in children influenced with Down's syndrome may have related with ocular findings such as hyperopia, nystagmus strabismus.

Galactosemia is because of transformation in galactokinase (GALK1).The galactitol collect does osmotic harm to the lens-"oil droplet cataract." It presents as nuclear cataracts but can also manifest as anterior or posterior subscapular cataract. Innate disease such as toxoplasma, rubella, cytomegalovirus, herpes, and syphilis (TORCH) are related with congenital cataract, with rubella being the most common.The occurance of TORCH infections is comperatively high in Indian subcontinent and up to 20% of cases may be seropositive.[4]

In India, the causes of traumatic cataract in children are different from that of Western population. Open-globe injury is three times more frequent than closed-globe injury, with bow and arrow injury being the most common causal agent. The other causes are firecracker, ball, stone, wood, and metal injuries. Cataract is oftenly associated with shallow anterior chamber, hyphema, corneal perforation/scarring, iris distortion, posterior synechiae, vitreous hemorrhage, vitreous in anterior chamber, and posterior capsular tear.[5]

A detailed history is taken that incorporates getting some information about the age of onset and duration of symptoms. First complain is often leukocoria, which the parent notices either total or gradual increment in the size of haziness. The second is child not following object near to face or not visually connecting (inability to recognize mother). squeezing of eye in bright light, squinting of eyes also complain of the parent , small eyes (microphthalmos), large eyes (buphthalmos), and abnormal movement of the eyes (nystagmus).[6]

Congenital cataract has a good prognosis if diagnosed early and if intervention is done before 6 weeks. Delayed diagnosis in childhood is often caused by delayed presentation because of ignorance and lack of facilities. Factors that may affect the visual outcome adversely include presence of a unilateral cataract, presence of nystagmus, strabismus, or any visual deformity that ranges from 2 months to 6 month of age which is the critical period for the growth and development of eye.[7] Emmetropization of an eye is generally attain by 9 years of age, but the plasticity of the visual pathway continues well beyond the first decade of life. Surgery is advised in visually significant opacities, i.e. more than 3-mm central opacity. Unilateral cataracts should be operated as early as possible before 6 weeks of age and bilateral cataracts should be operated before 8 weeks of age.[8] The second eye is operated within 1 week of the first eye and in children who are systemically unstable, can be performed in the same sitting in symmetrical cataract. axial length (AL) growth and myopic shift in pseudophakic children is difficult to predict. AL increases rapidly in the first 6 months (0.46 mm/month), then has a relatively slower (infantile phase) growth (0.15 mm/month) till 18 months, followed by a slow (juvenile phase) growth (0.10 mm/month).[9] The absolute error in children is higher compared to adult population. AL measurement is better calculated with immersion A-scan than indentation A-scan. In spite of this, indentation method is more commonly used than immersion AL (82.4% vs. 17.6%). Hence, we should take A-scan reading with maximum anterior chamber depth.18 Taken in the developing countries where postoperative care and follow-up are difficult.[10]

Pediatric cataract surgery is the stepping stone of a long, complex visual rehabilitation program. Various studies have been conducted on visual outcomes and complications following cataract surgeries in pediatric Age group. Late detection, inadequate surgical facilities for children, lack of pediatric anesthesia, and inadequate follow-up are the factors which result in poor visual outcome in many developing countries. In bilateral total congenital cataract patients, early primary surgery led to better visual acuity and low Postoperative Complication occurrence.[11]

MATERIALS AND METHODS

This Cross sectional observational study was conducted in Department of Ophthalmology, King George's Medical University (KGMU), Lucknow after getting approval from the institutional ethical committee. Informed written consent was taken from parent of each child for the study. Duration of study was One year.

All patients of cataract below 12 years operated in unit one between 2015 -2019 were considered for study. Available medical records of patients were screened and data was collected from the records. Examination of included patients was done to assess visual functions among selected patients.

Inclusion Criteria

- All patients of pediatric cataract operated in last five years in Unit –I, of department of Ophthalmology, KGMU, Lucknow.

Exclusion Criteria

- In complete medical records.
- Children non cooperative for assessment of visual functions.

Methodology: The medical records of pediatric cataract patients who underwent cataract surgery between 2015-2019 were screened. Out of 391 patients undergoing cataract surgery during that period, 300 patients with complete medical records were identified and telephonically called for assessment of visual functions. A detailed ophthalmic workup was done for all patients who turned up and following parameters were assessed during examination upon their visit:

- Duration since cataract surgery (A minimum of 6 months period since surgery was considered for assessing outcomes)
- Best corrected distant visual acuity (BEs) by fixation [CSM method], Teller acuity, Lea chart or ETDRS chart depending on the age of the

patient. Visual acuity scores in Logmar units were used for analysis.

- Refractive error (Spherical equivalent of refraction was considered. Refractive error was classified into Myopia and Hypermetropia. These were further grouped into refractive error less than and more than 2 dioptres for analysis.)
- Stereoacuity for near using Randot chart
- Anterior and posterior segment of the eye

The following information was retrieved from the past medical records:

- Demographic profile (including gender/education/socioeconomic status)
- Age at presentation and at surgery
- History of presentation (including complaints/onset/duration/trauma/family history)
- Laterality of cataract (unilateral/bilateral)
- Associated systemic or ocular co-morbidities
- Diagnosis
- Ocular biometry including AL & keratometry
- Calculated IOL power and amount of reduction done
- Type of surgery in case of bilateral cataracts: Simulatneous Bilateral Cataract Surgery or Delayed Sequential Cataract Surgery
- Per-operative complications
- Post-operative refraction (within first week of surgery)
- Post-operative PCO formation and management (Laser or Surgical)
- Visual acuity for distance at presentation and post-surgery (within first week of surgery)
- Stereoacuity for near at presentation and post-surgery (within first week of surgery)

Sample Size and Statistics

All patients with complete medical records were called for examination. All consecutive patients who turned up were included in the study. Descriptive analysis was done for the entire cohort. Qualitative data was expressed in percentages whereas quantitative data was expressed in mean, median with standard deviation and range. Independent-t test was applied to compare visual acuity and stereopsis between groups. The statistical analysis was done using Statistical Package for Social Sciences software version.[21] A 95% confidence interval was considered and a 'p' value of <0.05 was considered statistically significant.

RESULTS

A total of 390 children(below 12 years of age) were operated for cataract between 2014 and 2019 (5 years) in Unit 1 of the department of ophthalmology, KGMU. These patients were contacted and of these 81 patients came for follow up during the study period. Some of the phone numbers had changed and several patients could not come due to COVID 19 related lockdown and apprehension about travelling.

Among 81 children recruited in our study: 45 were male (55%) and 36 were female (44.4%). Mean age of patients was 5.9 years SD +3.4 years. Their mean age at diagnosis was 2.7 years +2.8 years and mean age at surgery is 3.5 years SD+2.9 years. Mean age of males was 3.53 years and that of females was 3.50 years. Mean duration of follow up was 1.92 years +1.37 years.

54 children (66%) had bilateral cataract and 27 children (33%) had unilateral cataract. Mean BCVA (log mar) as determined using an age appropriate method (fixation, Teller's preferential looking chart orSnellen) in RE was 0.81, and LE was 0.89atfollowup.Mean stereo acuity for near on Randot chart in cooperative 28 patients was 158.93+ 102 .8 seconds of (range 70 to 400 arc).

Table 1: Descriptive analysis of patients

	N	Mean	Minimum	Maximum	Std. Deviation
Age (yrs)	81	5.9911	.50	15.00	3.44267
Age at Diagnosis(yrs)	81	2.7089	.08	11.60	2.80868
Age at Surgery(yrs)	81	3.5233	.20	12.00	2.99760
Delay in Surgery(month)	81	10.9938	1.00	36.00	8.52588
Duration of follow Up(yrs)	81	1.9256	.08	6.00	1.37052
Log MAR RE	81	.8133	.00	3.00	.60811
Log MAR LE	81	.8963	.00	2.00	.57677
Stereo acuity(arc)	28	158.93	70	400	102.825

32 children (39%) had ocularor systemic comorbidity. of 125.29 seconds of arc against 210.91 seconds of arc in among those with co morbid conditions. (p=0.028)

Mean BCVA in among those operated for cataract within one year of diagnosis was 0.801.

Table 2: Correlation of Delay in Surgery, Laterality & Comorbidities with Visual Outcomes

	BCVA(log mar)	P value	Stereoacuity	P value
Delay in Surgery				
– < 1 years	0.801	0.221	148.1	0.344
– > 1 years	0.95		191.43	
Laterality				
– Unilateral	0.848	0.99	161.43	0.9
– Bilateral	0.95		156.43	
Co morbidity				

– Present	0.931	0.242	210.91	0.028
– Absent	0.795		125.29	

LogMAR units comapared to 0.950 in among those operated after more than one year of diagnosis. Though there was slightly better BCVA observed in those who had earlier surgery, this was not statistically significant (p=0.131) Of the 28 patients cooperative for stereopsis assessment, 21 were operated within 1 year of diagnosis and achieved a mean stereoacuity of 148.10 seconds of arc compared to mean stereo acuity of 191.43 in among those 7 patients whose surgery was delayed by over a year (p value = 0.900).

54 children who had bilateral cataract achieved a mean BCVA of 0.950 and 27 who had unilateral cataract achieved a mean BCVA of 0.848. (p=0.990). 14 patients were cooperative for stereoacuity assessment in both groups and the difference amongst both was insignificant (p=0.900) 32 patients with co-morbidities achieved a mean BCVA of 0.931compared to a mean BCVA of 0.795 among those without co-morbidities (n=49). This difference was statistically insignificant (p=0.242). However, children without co-morbidities achieved a significantly better stereroacuity.

Table 3: Correlation of immediate postop refractive error with visual outcomes

Immediate postop refractive error	N	BCVA(log mar)	P value		N	Stereoacuity	P value
Myopia<-2D Myopia>-2D	17 6	0.635 0.383	0.106		11 5	111.8 188.0	0.098
Hypermetropia <2D >2D	17 39	0.917 0.979	0.666		6 6	283.33 96.67	0.005

Most of the patients (n=56) had an immediate post-operative hypermetropia. This is logical as undercorrection of the calculated IOL power is done in children smaller than 2 years of age. While the eventual achieved BCVA does not seem to vary significantly with the immediate post-operative refractive error probably because the children are given suitable refractive correction after the surgery, best stereopsis (mean 96.67 seconds of arc) is achieved by children who have a hypermetropia of greater than 2 D after surgery (p value =0.005).

Table 4: Correlation of age at surgery with change in refractive error (myopic shift)

Age At Surgery	N	Refractive error (Mean Myopia In Diopters)	P Value	Age At Surgery	N	Refractive Error (Mean Hyperopia In Diopters)	P Value
Final refractive error				Final refractive error			
<2yr	4	-3		<2yr	29	2.04	
>2yr	19	-1.81	0.002	>2yr	29	0.13	0.001
Immediate postop refractive error				Immediate postoperative refractive error			
<2yr	4	-1.68		<2yr	28	3.64	
>2yr	19	-1.39	0.488	>2yr	28	2.17	0.001

Amongst the children who achieved a myopic refractive error in the immediate post-operative period, the myopic shift was greater in children younger than 2 years of age, about 1.4 D against 0.4 D in older children. This difference is statistically significant. However, amongst children initially hypermetropic the myopic shift was lesser in younger children i.e. 1.6 D against 2.0 D in children older than 2 years.

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Table 5: Correlation of refractive error at last follow up with visual outcome

Residual refraction	N	BCVA(log mar)	P value		N	Stereoacuity	P value

Myopia<2D	18	0.772	0.397		6	151.67	0.524
Myopia>2D	16	0.923			10	188	
Hypermetropia							
<2D	14	0.672	0.046		4	135	0.383
>2D	23	1.021			4	95	

18 patients developed Myopia < 2D whereas 16 patients went on to develop Myopia >2D after surgery and IOL implantation. Though the visual acuity scores were better in those with lesser Myopia, this difference was statistically insignificant (p=0.379).

The BCVA among those patients with Hypermetropia < 2D was better than in among those with Hypermetropia >2D. This difference in BCVA between groups was statistically significant (p=0.046). Thus, patients with residual Hypermetropia of >2D were found have poorer visual outcome.

Children with mild eventual hyperopia had the best visual acuity (p= 0.046). There was no statistical difference in the eventual refractive error and the achieved stereopsis.

Children operated before 2 years of age had significantly better binocular outcomes (mean 85 seconds of arc) compared to those operated after 2 years of age (mean 164.62 seconds of arc) (p value= 0.016).

DISCUSSION

Attempt was made to contact 390 children who were operated for cataract in the previous 5 years. However, only 81 children came for follow up with their old records during the study period. Rest of the patients did not come due to COVID-19 related lock down and apprehension about travelling. Some parents refused to be included in the study and did not come as their children were asymptomatic. Several had changed their phone numbers and could not be contacted. Thus, 81 children were included and underwent analysis of records and clinical examination.

Mean age of these patients was 5.9 years, of which 45(55.6%) were male and 36(44.4%) were female. There was no gender predilection. The slightly larger number of male children is because traumatic cataract had been included in our study and trauma is more frequent in male children.

In our study the mean age at diagnosis that is first symptom which was noticed by their parents was 2.7 + 2.8 years and the mean age at surgery was 3.5 + 2.9 years, demonstrating an approximate delay of about 1 year between diagnosis and surgery. Which is classified in two groups, with delay in surgery less than one year and the other with delay of more than one year, our study shows no significant difference in the visual outcome (p=0.221). In first group mean BCVA (Log MAR) was 0.801 and in other group it was 0.950, which shows that early surgery has better visual recovery however the difference is not statistically significant.

This result of our study is similar to another study by Parikshit M Gogate et al,[12] who have shown that delay between diagnosis of cataract and cataract surgery is not a statistically significant variable affecting visual rehabilitation. Thakur et al,[13] (2004) have also shown that late presentation leading to deprivation amblyopia and not the delay after diagnosis is the primary cause of a poor visual outcome. Weisberg et al,[14] and Lambert et al,[15] have shown that preoperative strabismus is a better clinical indicator of impending dense amblyopia and compromised visual prognosis in unilateral cataract.

In our study 54 children (66 %) cases had bilateral and 27 children (33%) had unilateral cataract. On correlation of laterality with visual outcome, p value of 0.990shows no significant association, similar to study done by Santosh chaudhary et al.[16]

Our result can be explained by the fact that unilateral developmental cataract is associated with poorer visual outcome but unilateral traumatic cataract has better outcome compared to bilateral developmental cataract. As our unilateral group had both developmental and traumatic aetiologies, the results got diluted. Excluding traumatic cataract from analysis would be more meaningful.

32 patients had a coexistent ocular comorbidity (strabismus, nystagmus, trauma etc). Correlation of eventual BCVA with co-morbidities demonstrated statistically insignificant association. However, the binocular recovery on Randot stereoacuity chart (for near) was significantly better (p=0.028) in children without ocular co morbidity. The visual acuity findings are similar to a study by Bradford et al (1994).[17] who have suggested that the presence of ocular comorbidities is not a poor prognostic factor. Presence of strabismus also has been shown to have no significant correlation with visual outcome (P=0.64).

Significant correlation of binocular recovery (on Randot Chart) with ocular comorbidity has also been shown by Webber and Wood,[18] (2005) who demonstrated that the most common deficit associated with amblyopia under ordinary (binocular) viewing conditions is impaired stereoscopic depth perception.

Most of the patients (n=56) had an immediate post-operative hypermetropia. This is logical as undercorrection of the calculated IOL power is done in children smaller than 2 years of age. While the eventual achieved BCVA does not seem to vary significantly with the immediate post-operative refractive error probably because the children are given suitable refractive correction after the surgery, best stereopsis (mean 96.67 seconds of arc) is

achieved by children who have a hypermetropia of greater than 2 D after surgery (p value =0.005). This could be due to the progressive myopic shift towards emmetropia which supports development of binocularity. It could also be due to the fact that higher hypermetropia is aimed in smaller children who seem to be at an advantage for development of binocular vision. They could also be more compliant to glasses as their dependence on them would be higher, due to higher refractive error. Our findings suggest that aiming for moderate hyperopia in post-operative period appears to be logical in young children.

Children with mild eventual hyperopia had the best visual acuity (p= 0.046). There was no statistical difference in the eventual refractive error and the achieved stereopsis. It would be logical to aim for mild eventual hyperopia for ideal visual outcomes.

Among the children who achieved a myopic refractive error in the immediate post-operative period, the myopic shift was greater in children younger than 2 years of age, about 1.4 D against 0.4 D in older children. This difference is statistically significant. However, amongst children initially hypermetropic the myopic shift was lesser in younger children i.e. 1.6 D against 2.0 D in children older than 2 years.

These findings highlight that the myopic shift is unpredictable. The myopia increases rapidly in younger children but the hypermetropia decreases at a slower rate in them. Aiming for mild to moderate hypermetropia appears logical in early postoperative period to compensate for the myopic shift.

Study by McClatchey et al have demonstrated greater myopic shift in children aged 2 years and younger at time of surgery. They also found a greater variance in the predicted refractive change compared with those >2 years old at time of IOL implantation. Our data is also compatible with these findings. Study done by J S Barry et al showed that refractive outcome for each eye was not entirely predictable and was variable between infants.

Children operated before 2 years of age had significantly better binocular outcomes (mean 85 seconds of arc) compared to those operated after 2 years of age (mean 164.62 seconds of arc) (p value= 0.016). From this correlation it is clear that early surgery leads to better binocularity.L. Lesueur,[19] et alanalyse functional results in children with unilateral and bilateral cataract surgery whose surgery were performed earlier that to before the development of abnormal foveal function, their visual and binocularity was better.

CONCLUSION

Mean distance visual acuity of 0.8 LogMAR and mean near stereopsis of 158 seconds of arc are achieved in the long term. The eventual visual outcomes are not related to delay in surgery or laterality of cataract. Better stereopsis is achieved in absence of ocular comorbidities. In children below 2 years of age myopic shift is faster in children left myopic initially than those left hypermetropic. Early surgery and moderate hypermetropia in the immediate postoperative period favour better long term stereopsis. Best visual acuity is achieved in presence of mild long term residual hypermetropia. Early diagnosis and management of Pediatric Cataract may improve the visual outcomes. Screening of preschool children may help in early diagnosis. Immediate postoperative myopia in these children is undesirable and should be avoided. A moderate postoperative hypermetropia should be aimed.

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