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METHODS

Surgical outcome of intraocular lens implantation in children with bilateral developmental cataract

Nasimul Gani Chowdhury [1], Sujit Kumar Biswas[2*], Wahid Alam[3], Dostogir Hossain[4], Jannatun Noor[5] and Urmi Atika Islam[5]

[1]Senior Consultant, Pediatric Department, Chittagong Eye Infirmary and Training Complex, Chittagong, Bangladesh
[2]Consultant, Cornea Department, Chittagong Eye Infirmary and Training Complex, Chittagong, Bangladesh
[3]Associate Consultant, Vitreoretinal Department, Chittagong Eye Infirmary and Training Complex, Chittagong, Bangladesh
[4]Senior Assistant Surgeon, Glaucoma Department, Chittagong Eye Infirmary and Training Complex, Chittagong, Bangladesh
[5]Teaching Assistant cum Optometrist, Institute of Community Ophthalmology (ICO), Chittagong Eye Infirmary and Training Complex Campus, Chittagong, Bangladesh

*Correspondence:
Sujit Kumar Biswas,
dr.sujitkumar2020@gmail.com

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Purpose: To evaluate the visual outcome and long-term complications of intraocular lens implantation along with primary posterior capsulectomy & anterior vitrectomy in children with bilateral developmental cataract.
Methods: This retrospective study was carried out on the 48 eyes of 24 children who had undergone cataract surgery under general anesthesia. Age range was 2 to 8 years. All patients underwent primary posterior capsulectomy, primary in-bag intraocular lens (IOL) implantation, irrigation-aspiration of lens debris, and anterior vitrectomy. At intervals of one week, one month, three months, and six months, every case was evaluated. After 6 months best corrected visual acuity was recorded and intraocular pressure, anterior chamber angle, optic disc, and peripheral retina were evaluated.
Results: Postoperative best corrected visual acuity were 6/6 in 10.4% eyes, 6/9-6/18 in 56.3% and $<$ 6/18 in 33% eyes. Intra ocular pressures were found within normal limit (12 $\pm$ 2.09 mm of Hg) in all cases. Anterior chamber angle was normal in 44 eyes (91.7%). Peripheral retina and vitreous were normal in all cases. No significant Optic disc changes were noticed. The most common cause of decreased vision was amblyopia (79.2%) in the fellow eye due to delayed surgery.
Conclusion: Amblyopia is the main cause of decreased visual recovery in children after cataract surgery. Surgical intervention in proper time results in good visual outcome.

Keywords: developmental cataract, primary posterior capsulectomy (PPC), anterior vitrectomy (AVT), amblyopia.

Introduction

A contributor to childhood blindness is childhood cataract. The global prevalence of childhood cataract is 1.2 to 22.9 per 10,000 births (1). It may be congenital or acquired presented unilaterally or bilaterally. Majority of cases need surgical intervention to prevent amblyopia and improve vision (2). Cataract extraction with in-bag intraocular lens implantation is the main surgical intervention but most of them develop posterior capsular opacification (PCO) postoperatively and this is the main complication of visual deterioration (3). Capsular opacification is not eliminated only by primary posterior capsulectomy (PPC) as dens vitreous acts like a scaffold for cell migration which eventually closes the posterior capsular opening (4–7). Thus cataract extraction along with posterior capsulectomy and anterior vitrectomy (AVT) are routinely done to prevent the PCO and maintain visual axis clear (8–13).

Delayed surgery results in visual deprivation amblyopia and thus timely management is very important to prevent

amblyopia. Here we try to evaluate retrospectively the visual outcome and long-term complications of intraocular lens implantation along with PPC and AVT in children with bilateral developmental cataract.

Research elaborations

Patients and methods

This retrospective study was conducted at Chittagong Eye Infirmary and Training Complex from June 2016 to June 2020. Twenty four children who had undergone bilateral cataract surgery with relatively good health were included in this study. The age range of the study population was 2 to 8 years. Mentally retarded, systemic diseases associated and poor health related children were excluded from this study.

A single pediatric ophthalmologist performed each surgery. Follow-up range was 6 to 48 months. IOP measurement, anterior chamber angle and optic disc evaluation were done by glaucoma consultant. Peripheral retina was examined by a retinal surgeon.

Visual acuity, papillary reaction, slit lamp examination, fundus examination and B-scan done preoperatively in all patients. IOL power was calculated using the SRK-II formula, and it was then modified using Dahan's formula. Central, Steady and Maintained (CSM) method, KAY picture chart, ETDRS chart and Snellen chart were used for recording visual acuity.

With spontaneous breathing, general anesthesia (GA) was used for all cataract procedures. Investigations for GA such as complete blood count (CBC) and X-ray chest P/A view were done and pre-anesthetic checkup by an anesthetist was ensured. Intubation was done with laryngeal mask airway (LMA) and sevoflurane used as inhalation agent during anesthesia.

Surgical technique

Preoperatively pupils were dilated with 10% phenyleprine and 1% tropicamide eye drops. The ocular adnexa and the surrounding skin were cleaned with 5% povidone iodine. The eye was draped with sterile cloths and plastic materials. Corneal tunnels were performed using an MVR blade at the eleven and two o'clock locations. Tryptan blue stains the lens' anterior capsule. Continuous curvilinear capsulorrhexis (CCC) was performed by a cystotome needle. Irrigation and aspiration (I/A) were performed with an automated irrigation-aspiration hand piece with the Optikon 2000 S.P.A system was used (Model-PULSAR-2).

Soft foldable hydrophobic acrylic lenses (Alcon, MBI) were placed in bag in all cases. An automated vitrectomy machine was used to complete PPC and AVT. Corneal tunnels were closed by 10-0 nylon. All patients received sub-conjunctival injections of dexamethasone (2 mg) and gentamicine (5 mg).

After a single day of surgery, kids were discharged from the hospital. The following follow-up intervals were scheduled: 7, 1, 3, and 6 months. Eye drops containing atropine and antibiotics were used for a month. Corticosteroid eye drops were used in titrating dosages for eight weeks. The CSM technique, crowded Kay picture test (KPT), Lea symbol, and Snellen charts were used to estimate the distance VA. Subjective refraction was performed and best corrected distance visual acuity was reported in every follow-up. After two weeks, a refraction and a prescription for glasses were provided. Part-time occlusion (4–6 h per day) and active vision treatment were used for amblyopic eyes. Anterior Chamber angle, IOP, optic disc changes, and peripheral retina were evaluated after 6 months.

SPSS version 16 was used for statistical analysis. A *'p'-value* of < 0.05 was used as statistically significant.

Results

Out of the 24 patients (48 eyes) 18 patients were boys and 6 were girls. The mean was 4.83 ± 2.09 years (range 02–08 years (**Table 1**).

Time interval of surgeries between two eyes was 3.33 ± 3.07 months. The mean follow up period was 32.6 ± 2.12 (range 6–48 months). Postoperative visual acuity of the respondents after 6 months is depicted in **Table 2**.

Postoperatively, refractive error was not found in 6.2% cases and 'with the rule' astigmatism was highest in number (70.8%) (**Table 3**).

Among the 48 eyes, 38 eyes were amblyopic and 10 eyes were normal. Amblyopic patients were given part time occlusion with active vision therapy (**Table 4**).

Visual axis obscuration was noticed in one eye of a patient due to thick membrane and after 6 months surgical membranectomy was done with satisfactory outcome.

TABLE 1 | Age of the respondents.

Age	Male (%)	Female (%)	Total percentage
2-4	47.83	8.7	56.53
5-8	26.08	17.3	43.38
Total	73.91	26.09	100

Chi square = 15.12 ($p > 0.05$); Phi and Cramer's V = 0.794 ($p > 0.05$)

IOP was normal in all cases (12 ± 2.09 mm of Hg). Gonioscopy revealed angle recession in one eye of one case whose cup disc ratio was 0.6 with healthy neuroretinal rim. Peripheral anterior synechiae were found in 3 cases (6.2%). All other cases showed wide open angle (91.7%) (**Table 5**).

No significant glaucomatous optic disc changes were noticed. Peripheral retina and vitreous were normal in all cases. Cup disc ratio (CDR) was 0.2 for both eyes in most cases (43.72%) (**Figure 1**).

TABLE 2 | Postoperative visual acuity of the respondents.

Visual acuity	Number	Percentage
6/6	5	10.4
6/9-6/18	27	56.3
<6/18-3/60	9	18.4
<3/60	1	2.1
CSM (+ve)	5	10.4
CSM (−ve)	1	2.1
Total	48	100

CSM-Central, Steady, and Maintained.

TABLE 3 | Refractive status of the respondents.

Types of refractive error	Number	Percentage
Emmetropia	3	6.2%
Hyperopia	3	6.2%
WTR astigmatism	34	70.8%
ATR astigmatism	2	4.2%
Oblique astigmatism	6	12.5%
Total	48	100

WTR, With the rule; ATR, against the rule.

TABLE 4 | Status of amblyopia.

Amblyopia type	Number	Percentage
Non - amblyopic	10	20.8%
Mild Amblyopia (6/9–6/12)	21	43.8%
[Frame1] Moderate Amblyopia (6/18–6/36)	13	27.1%
Deep amblyopia (>6/60)	4	8.3%
Total	48	100.0

TABLE 5 | Presentation of gonioscopic findings.

Gonioscopic findings	Number	Percentage
Peripheral anterior synechiae	03	6.2%
Angle recession	01	2.1%
Wide open angle	44	91.7%
Total	48	100

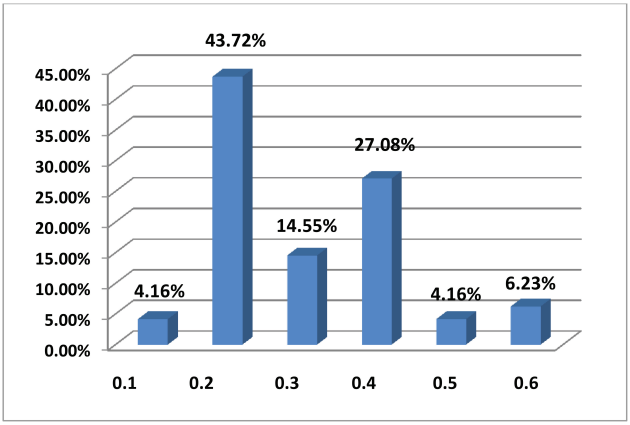

FIGURE 1 | Percentage distribution of CDR of both eyes.

Discussion

This study aimed to investigate the visual outcome and long-term complications of PPC and AVT in developmental cataract in children. Appropriate time of surgery is needed to avoid irreversible visual damage (14). Surgery should be done before binocular interaction develops (15).

In younger children it is very important to manage posterior capsule in cataract surgery with intraocular lens implantation. Amblyopia may develop in children due to rapid development of posterior capsular opacification (16). Thus PPC in young children is preferred method for maintaining a clear visual axis. But in small children intact anterior vitreous face acts a scaffold for lens epithelial cell migration as well as proliferation results in fibrous membrane. So anterior vitrectomy is needed along with posterior capsulotomy young children (9).

Gimbel et al. that children over 2 years old do not need routine AVT during cataract surgery as ocular development may be hampered due to vitreous removal (17). David Taylor (18), Koch DD (17) and Vasavada A et al. (19) reported that capsulorrhexis and in bag implantation and PPC with AVT were the effective methods of preventing development of PCO in children. Similar to other studies, we agree to this idea that PPC with AVT maintains visual axis clear in long time. In our study, one eye developed thick membrane in visual axis after 6 months and surgical membranectomy was done afterward with satisfactory outcome.

In our study optic disc was evaluated by a glaucoma consultant. Cup disc ratio (CDR) was within normal limit and neuroretinal rim was healthy in all cases. In our study intraocular pressure was within normal limit in all cases. So, short-term use of topical and systemic steroid did not influence the intraocular pressure in our cases. No steroid responder was found. Angle recession was found in one eye of one case whose CDR was 0.6. The exact cause of angle recession in this case could not be identified. Peripheral retina was evaluated by a vitreoretinal consultant after full dilation and it was normal in all cases. No retinal

detachment, vitritis, or degenerative change in vitreous was observed. So, precise and refined vitrectomy seems to be safe in children.

In this study, 56.3% eyes achieved a postoperative best corrected visual acuity of ≥6/18. In studies from central India and Nepal these were 16.4 and 36.6% respectively (20, 21)but these series included some traumatic cataracts too. At the final follow-up visit, a majority patients (66.7%) of our study had a postoperative best corrected visual acuity of 6/9-6/18. The decreased vision in second eye was due to development of amblyopia because of delayed surgery. Other factors include negligence for treatment and non-compliance with occlusion therapy. Visual prognosis also depends on age of presentation, state of lental opacity, and proper treatment maintained by parents and their child. Postoperative management and minimum interval between surgeries of two eyes are very important to avoid amblyopia (22). In bilateral cataract after operation in first eye, the second eye may be operated within a week or two to prevent amblyopia. In our study majority post-operative refractive errors were with the rule Astigmatism (70.8%). So spectacle compliance & Amblyopia treatment outcome were satisfactory.

Cataract surgery in children is not like as adult cataract surgery. Because pediatric eye differs from adult eye in terms of low scleral rigidity, high intra-lenticular pressure, unstable axial length, excessive inflammation and aggressive PCO, which poses surgical procedure and overall outcome troublesome and challenging. Despite good surgery, sometimes vision doesn't improve due to amblyopia which needs occlusion therapy, regular follow-up for long time and treatment compliance. Even after occlusion therapy for reasonable time and good compliance, visual acuity may not improve and needs treatment with low vision aids. Pediatric eye needs to be operated under general anesthesia with some additional procedure like anterior vitrectomy with automated vitrectomy machine. Good surgical expertise and well-functioning machinery support are prerequisite for satisfactory surgical outcome. Recently intraocular lens implantations before 2 years are gaining popularity for prompt visual rehabilitation and good binocular function. Aphakic management with heavy spectacle is difficult and binocular function can't be achieved. Later on it needs secondary implantation again under general anesthesia. During secondary implantation in bag placement may not be possible due to capsular fibrosis. So, in sulcus placement with multi piece lens remains the only option which may cause a lot of complications. Hence primary in bag intraocular lens implantation with PPC and AVT allows early restoration of vision & good comfortable visual rehabilitation.

Conclusion

Amblyopia is one of the important issues in decrease visual acuity after cataract surgery in children. Amblyopia can be avoided as well as achievement of good vision surgery in the fellow eye should be done within least reasonable time. Counseling regarding amblyopia and importance of regular follow-up should be intensified. Primary intraocular lens implantation, PPC, and AVT are safe methods for visual rehabilitation in children in appropriate time.

Author contributions

NGC: manuscript writing and study design. SKB: manuscript writing and proof correction. WA: literature review. DH: Data interpretation. JN: data collection and statistical analysis. UAI: data collection and statistical analysis. All authors contributed to the article and approved the submitted version.

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