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Challenges and Consequences of IOL-Implantation in Children with Congenital Cataract before the Age of One Year

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Abstract:-

- ***Aim***

To evaluate the intra-operative challenges and post-operative consequences of IOL implantation in children before the age of one year.

- ***Methods***

40 eyes of 20 patients with congenital cataract underwent cataract surgeries under general anesthesia were included in this study. Mean age was 9±1 months (7 months to 1 year). All the cases were reviewed at 1 week, 1 month, 3 months and 6 months intervals. The cases completed at least 6 months follow up were included in this study. Intra-operative difficulties, post-operative complications and final visual outcome were recorded.

- ***Results***

Small eyeball, anterior capsular calcification, thick posterior capsular plaque and pre-existing posterior capsular dehiscence are the major intra-operative challenges. Treatment incompliance, secondary membrane formation, increase intraocular pressure and it's measurement, changes in refraction and amblyopia are the important concern of IOL implantation in children before the age of one year.

- ***Conclusion***

Stimulus deprivation amblyopia is the main cause of decreased vision after IOL implantation in children before 1 year of age. Primary IOL implantation after 7 months is safe method to avoid amblyopia and obtain visual rehabilitation in small children.

Keywords:- *Congenital Cataract, IOL-Implantation, Challenges and Consequence, before One Year of Age, Single Piece IOL.*

I. INTRODUCTION

Children might have unilateral or bilateral cataracts, either congenital or acquired, and most of them are treatable.[1] The visual prognosis for pediatric cataract has greatly improved due to advancements in surgical techniques and intraocular lenses (IOLs).[6] The most important complication of pediatric cataract surgery is still visual axis opacification.[2] Primary posterior capsulectomy (PPC) combined with Anterior vitrectomy (AVT) are needed during surgery to prevent visual axis opacification after pediatric cataract surgery.

Recently IOL implantations before one year of age are gaining popularity since they allow for prompt visual recovery and good binocular performance[3,4]. Binocular function cannot be achieved and aphakic management is uncomfortable when wearing heavy spectacles.[7] It will eventually require another secondary implantation of IOL again under general anesthesia. Because of capsular fibrosis, secondary in bag placement of IOL may not be possible.[13,14] Therefore, the only alternative for sulcus placement is a three-piece lens, which could be very problematic. Primary in-bag IOL implantation with PPC and AVT enables prompt visual recovery and comfortable visual rehabilitation.[15]

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Hence, the purpose of the study was to evaluate the intra-operative challenges and post-operative complications after IOL implantation in children before 1 year of age.

II. MATERIALS AND METHODS

This retrospective observational study was conducted in 40 eyes of 20 children aged between 7 months to 1 year who were diagnosed as congenital cataract previously and surgeries were performed in Chittagong Eye infirmary & training complex (CEITC), Chattogram between June 2021 to June 2023. Information regarding age at surgery, sex, preoperative axial length reading, intra-operative difficulties, post-operative refraction and complications were recorded. Children associated ocular anomalies and systemic disorders, age above 1 year and follow up less than 6 months were excluded. All surgeries were performed by a single pediatric surgeon under general anesthesia.

The preoperatively visual acuity assessment (CSM method), slit lamp biomicroscopy, direct and indirect ophthalmoscopy after full dilatation and B-scan ultrasonography were performed in each patient. Intraocular lens (IOL) power calculations were done on the basis of axial length (Ocuscan machine) proposed by Dahan E and Drusedau MU[8] and under correction by 20% [Table 01].

Table 1: Axial Length & IOL Power Calculation Proposed by Dahan E and Drusedau MU

Axial length (mm)	IOL Power (D)
17	28.00
18	27.00
19	26.00
20	24.00
21	22.00

➢ *Surgical Technique*

With aseptic precaution all patients underwent cataract surgeries under general anesthesia with spontaneous ventilation. The MVR blade was used to create corneal tunnels at the 11 and 2 o'clock positions. To dilate the pupil, adrenaline was injected into the anterior chamber. The anterior capsule of the lens was stained using trypan blue. The 25G ILM forceps (Alcon) were used to perform continuous curvilinear capsulorrhexis (CCC). Irrigation and aspiration (I/A) was carried out in every cases by using an automated I/A hand piece with an Optikon R-Evo Smart machine. In every cases, soft, foldable, hydrophobic acrylic lenses (Alcon) were placed in capsular bag. An automated vitrectomy machine was used for both primary posterior capsulectomy (PPC) and anterior vitrectomy (AVT). 10-0 nylon was used to close the corneal tunnels. A sub-conjunctival injection of dexamethasone (2 mg) and gentamicin (5 mg) was used in every patient. The eye remain padded until the initial post-operative examination. All the patients were discharged on the next day of surgery and reviewed after 7 days, 30 days, three months and six months interval. Antibiotics eye drop was continued up to one month. Steroid eye drop applied and reduced slowly over the following 8 weeks. Systemic steroids (1 mg/kg body weight) were given orally in tapering dose. After 1.5 months from surgery, all of the cornea's sutures were removed under total intravenous ketamine anesthesia. During suture removal, intraocular pressure (IOP) were measured by Perkins tonometry. Refraction and spectacles prescription were given after one week. Post-operatively visual assessment, were done by CSM method & Cardiff acuity cards. Fundus examinations were done in every follow up visits after one months of surgery.

Statistical analysis was performed by SPSS software version 22.0. A P-value of <0.05 was defined as statistically significant.

III. RESULTS

Forty eyes of 20 children underwent cataract surgery under general anesthesia. Mean age was 9 ± 01 month (7 months to 1 year). Follow up range was 6 months to 3 years. 12 of the cases were male and 8 of the cases were female [Table 02].

Table 2: Age of the Patients at Surgery

Age at Surgery	Male	Female	Total
7 months- 9 months	4 (20%)	3 (15%)	7 (35%)
10 months- 12 months	8 (40%)	5(25%)	13 (65%)
Total	12 (60%)	8 (40%)	20 (100%)

The major intra-operative challenges were 4 small eyes (10%), anterior capsular calcification in 8 eyes (20%), thick posterior capsular plaque in 6 eyes (15%) and pre-existing posterior capsular dehiscence in 4 eyes (10%) [Table 03].

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Table 3: Major Intra-Operative Challenges

Intra-Operative Challenges	Number of Eyes	Percentage
Small eyes	4	10%
Anterior capsular calcification	8	20%
Thick posterior capsule	6	15%
Pre-existing posterior capsular dehiscence	4	10%

Invariably repeated shallowing of the anterior chamber was the troublesome intra-operative challenges of the cataract surgery in small kids. Suturing was done in every case even in side port. Centering of the eye was problematic during cataract surgery due to lightening of the anesthesia in 10 of cases (25%). There was no iatrogenic PC rent.

Visual assessment showed central, steady and maintained in 30% of cases & central, steady and unmaintained in 50% of cases. Rest of the cases showed 6/60 to 6/24 vision by Cardiff acuity cards. The average residual hypermetropia was 6.00D, reduced to 5.00D after 1 year. 2 eyes of 2 cases showed increased IOP that was managed conservatively. In rest of the cases IOP were within normal limit (13±2.09 mm of Hg). No significant optic disc changes were noticed. Peripheral retina and vitreous were normal in all cases. 2 eyes of 2 patients developed thick membrane and membranectomies were done later on. No pupillary optic capture of IOL was recorded.

The most common cause of decreased vision was stimulus deprivation amblyopia. Delaying of the surgeries in the fellow eye was the second most common cause of decreased vision and amblyopia due to competitive inhibition.

IV. DISCUSSION

Congenital cataracts are usually associated with nystagmus & strabismus[10]. So, parents should be counselled that visual prognosis after surgery would be guarded. In addition long term follow up & spectacle correction would be needed.

Now-a-days, IOL power under correction in pediatric cataract surgery is a challenging issue. Several studies have been conducted regarding axial length variations and IOL power under correction[11,12]. Many ophthalmologists recommend an under-corrected IOL power in children to provide an initial hypermetropia due to fast myopic shift, which causes changes in refraction[16]. Conversely, the degree of myopic shift varies from child to child and is not always predictable[5,17]. Due to recent advancement in cataract surgical techniques; intraocular lens materials and designs better visual outcomes are achieved[17].

Small eyeball, anterior capsular calcification, thick posterior capsular plaque, posterior capsular dehiscence and repeated shallowing of the anterior chamber are major intra-operative challenges of cataract surgery in small kids. In small eye we put the IOL if corneal diameter is more than 10 mm. Capsulotomies were done with 25G curved scissor (Alcon) or vitrectomy cutter in cataract having thick anterior capsular calcification. Vitrectorhexis were done by automated vitrectomy machine with low cut rate in case of thick posterior capsular plaque. Special care were taken to prevent cortex-vitreous admixture in case of pre-existing posterior capsular hole or dehiscence. Closed chamber technique was adopted to prevent repeated shallowing of the anterior chamber.

Post-operative residual hypermetropia, unpredictable axial length elongation, Intraocular pressure measurement, change in refraction and amblyopia were the major concerns of IOL implantation in children before the age of one year.

The accuracy of post-operative target refraction and the emmetropization of refractive error remain controversial, despite the evolution of surgical technique have made primary implantation a popular and feasible option for children under the age of one year[5]. Aphakia cause invariably amblyopia and there is chance of retinal detachment in future. In addition treatment compliance with heavy spectacle is poor.

In infants and young children, the anterior vitreous face is more reactive. Small children have a significant inflammatory response and fibrous membranes may form on an intact vitreous face[9]. Therefore, in infants and young children, posterior capsulectomy along with anterior vitrectomy is advocated[6]. In our series 2 eyes of 2 patients developed thick membrane even after precise anterior vitrectomy and membranectomies were done later on.

All patients had a cup disc ratio within normal limit and a healthy neuro-retinal rim. In our study intraocular pressure was found within normal limit except in 2 eyes of 2 patients. Therefore, the majority of our cases, the short-term use of topical and systemic steroids did not increase intraocular pressure. Peripheral retina was found normal after full dilation in all cases. There was no signs of RD, vitritis or degenerative changes in the vitreous. Thus, precise and refined vitrectomy is safe for children.

In our study no pupillary optic capture of IOL was recorded. This was because we avoided Atropine eye drop post-operatively. Instead, we used topical Tropicamide and Phenylephrine combination to keep the pupil reacting and mobile.

For bilateral cataract, second eye should be operated within two weeks of first eye's surgery to prevent amblyopia. In our study average residual hypermetropia was +6.00D which reduced to +5.00D after 1 year. Majority of post operative refractive errors were with the rule astigmatism

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(70.8%). Hence, the results of the spectacle compliance and amblyopia treatment were satisfactory.

Children's cataract surgery is not a simple version as that of adults. The surgical process and overall result are troublesome and challenging because the pediatric eye differs from the adult eye in terms of low scleral rigidity, high intra-lenticular pressure, unstable axial length, severe inflammation, and aggressive PCO. Sometimes vision does not improve due to amblyopia even after successful surgery which requires occlusion therapy, long-term follow-up, and treatment compliance. Visual acuity may not improve even after occlusion therapy for a reasonable time and low vision aids may be necessary. Pediatric eye surgery must be performed under general anesthesia with other additional procedures like anterior vitrectomy using an automated vitrectomy machine. A satisfactory surgical outcome requires both well-functioning machinery supports and skilled surgical expertise.

Our study has several limitations, such as a smaller sample size, short follow-up period, accurately quantifying visual acuity and intraocular pressure in preverbal children.

V. CONCLUSION

Stimulus deprivation amblyopia is the main cause of decreased vision after IOL implantation in children before 1 year of age. By implanting IOL in small kids, aphakia and it's troublesome management can be avoided and good binocular vision can be achieved. Primary IOL implantation after 7 months is safe method to avoid amblyopia and obtain good comfortable visual rehabilitation in small children.

The primary cause of decreased vision following IOL implantation before one year of age in children is stimulus deprivation amblyopia. By implanting IOL in small kids, aphakia and it's troublesome management can be avoided and good binocular vision can be achieved. Primary IOL implantation after 7 months is safe method to avoid amblyopia and obtain good comfortable visual rehabilitation in small children.

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