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RESEARCH ARTICLE

Outcomes of Paediatric Cataract Surgery in Southern Jordan

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Abstract:

Background:

Congenital cataract is the leading global cause of preventable childhood blindness, and the onset of infantile and congenital cataracts is rare. Managing congenital cataracts is still challenging due to associated complications.

Objective:

This study aimed to assess the outcomes of congenital cataract surgery with intraocular lens implantation in southern Jordan.

Methods:

A retrospective case series included 20 children with congenital cataracts who underwent lensectomy, aged between 1 to 5 years, recruited using a purposive sampling technique. The mean age was 2.9 years ± 1.4. Intraocular pressure was measured preoperatively at baseline and then every three months, followed up postoperatively until one year. Schiotz tonometer is used to measure intraocular pressure.

Results:

The distribution of IOP and change in IOP values at baseline and post-operative follow-ups showed statistically significantly higher IOP values at three months of follow-up (P=0.03) and the last follow-up visit at 12 months (P=0.001). The results showed a statistically significant increase from baseline in the IOP of the unilateral cataract eye compared to its normal fellow eye (P=0.028). The post-operative evaluation showed that 14 patients demonstrated twenty-seven post-operative complications. Four eyes (14.2%) with posterior synechiae, 2 (7.1%) with anterior synechiae, 3 (10.7%) with decentration of IOL, 8 (28.6%) with pigment on IOL, 3 (10.7%) with transient corneal oedema and 7 (25%) developed post-operative glaucoma.

Conclusion:

We concluded that post-operative follow-up of one year in pediatric patients treated with congenital cataract surgery showed a significant increase in intraocular pressure.

Keywords: Congenital cataract surgery, Intraocular pressure, Implantation, Pediatric, Intraocular lens, Childhood blindness.

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1. INTRODUCTION

The effectiveness and safety of pediatric cataract treatment have been improved with the advancement in amblyopia management and microsurgical techniques [1, 2]. However, managing congenital cataracts is still challenging due to associated complications of aphakic glaucoma and secondary lens opacification [3, 4]. Globally, congenital cataract is the leading cause of childhood blindness that is avoidable, even though the onset of infantile and congenital cataracts is rare and affects only 3-10 per 10,000 live births [5]. Therefore, its early detection and management is a priority among global health programs [5].

Among adults, one of the significant predictive factors for glaucoma development is central corneal thickness (CCT) [6, 7]. Similarly, in pediatric patients, there is an increased susceptibility to the development of glaucoma and inflammation post-cataract surgery [8 - 11]. Resende *et al*. [12] posit that the risk of postoperative increase in CCT following congenital cataract surgery is negatively correlated with age.

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Among all these studies, children were of different ages, and some were conducted among grownup children. The probability of regaining vision decreases with cataract removal delay during the initial months of infanthood with congenital cataracts [13]. The goal of congenital cataract surgery is to be performed at the most appropriate age to minimize the risk of glaucoma development in later years and attain optimal visual outcomes. There is no longitudinal study on the outcome of primary intraocular lens (IOL) implantation after the removal of congenital cataracts in children aged five years or less. Previously, Shatnawi *et al*. [14] studied cataract surgery management in pediatric Jordanian populations aged less than one year up to 8 years with hydrophobic IOL to mitigate visual axis opacification risk. Also, there is a lack of literature regarding the effect of CCT in children who had congenital cataract surgery with IOL implantation. In Jordan, at Alkarak Government Hospital, a gradual rise in the pediatric population aged less than five years with congenital cataracts was observed. This instigated the requirement to examine the results of IOL implantation in congenital cataract surgery in the pediatric population to provide baseline data on this region. Therefore, the study aimed to assess the outcomes of congenital cataract surgery with IOL implantation in southern Jordan, a developing region for dealing with cataract surgery complications.

2. MATERIALS AND METHODS

This study retrospectively recruited children with congenital cataracts scheduled for surgery with implantation of primary IOL at the Ophthalmology department, Alkarak Governmental Hospital, Alkarak, Jordan, from March 2015 to April 2019. This consecutive, case-by-case clinical study recruited 20 subjects due to scarce data. The sample was recruited using a purposive sampling technique. The parents of children with congenital cataracts gave written consent for conducting the surgery after clearly understanding the study objective. The study was initiated after approval from the ethics committee and complied with the Declaration of Helsinki developed by the World Medical Association to protect human subjects. The study included patients with congenital cataracts who underwent lensectomy, limited anterior vitrectomy with intraocular lens implantation, and ages between >1 to < 5 years. All patients with a history of trauma, microphthalmos, micro cornea, persistent hyperplastic primary vitreous, and those on topical drugs were excluded. Children with any syndrome, systematic abnormality, or other co-existing ocular morbidity were also excluded. Baseline demographics and clinical details were collected from enrolled participants, including medical history and ophthalmological examination. All children with mature congenital cataracts underwent a thorough ocular brightness modulation (B-scan) ultrasound to rule out retinal detachment, vitreous haemorrhage, and other posterior segment anomalies.

2.1. Measurements

The IOP was measured using a Schiotz tonometer (Sklar Instruments, West Chester, PA, USA) after instillation with “0.5% proxymethacaine HCl w/v” and “0.25% fluorescein sodium BP w/v” (Chauvin Pharmaceuticals Ltd, Kingston-Upon-Thames, Surrey, UK). The same examiner administered an injection of ketamine (2 mg/kg) intravenous as general anesthesia (GA) to measure IOP at the earliest (< 5 minutes) duration. Three consecutive readings were recorded for both eyes. After induction, three readings were retaken to recheck IOP as soon as the children calmed within 5 minutes. For IOL biometry, the corneal curvature of children was measured using a handheld keratometer (Nidek KM 500) (Nidek Inc., Fremont, CA) in a supine position and under general anesthesia in participants. It is one of the devices to measure corneal curvature in young or less cooperative children (as it can be used without general anesthesia). Axial length was measured using an ocular ultra-sound machine shortly after the intraocular pressure measurement in the operation room.

2.2. Surgical Technique

Under general anesthesia, the same surgeon performed implantation of IOL after performing a lensectomy and limited anterior vitrectomy with posterior capsulotomy. A paracentesis knife (15 degrees) was used to create two limbal side ports (1.0 mm wide tunneled) at 10 and 2 o'clock. A Trypan blue was injected in all cases for the anterior capsule visualization. A sodium hyaluronate ($C_{14}H_{22}NNaO_{11}$) of 1.4% was used to form the anterior chamber. Utrata forceps were used for continuous anterior capsulorhexis with a diameter of 5.0 mm approx. An automated irrigation/aspiration (I/A) handpiece was used to accomplish lens aspiration. The same limbal side ports *via* the anterior route were used for performing limited anterior vitrectomy (triamcinolone, which helps alleviate the redness, itchiness, swelling, and other pain brought on by skin disorders) and a primary posterior capsulotomy (3.5 mm). Among children over one-year-old, 'in-the-bag' implantation was attempted of a hydrophobic IOL. The incisions were then closed after removing the remaining ophthalmic viscosurgical material. All the children were prescribed topical cyclopentolate eye drops for 14 days, prednisolone eye drops, and tobramycin eye drops for 42 days in tapering doses. The frequency of eye drop doses was two drops four times a day.

2.3. Patient Assessment

As per the post-operative protocol used in routine cases of pediatric cataract surgery, all the patients were followed up for one year for readings collected at three months, six months, and 12 months. The examination of posterior and anterior segments was conducted at each visit. In each postoperative visit, all the children were placed under sedation anesthesia for the IOP measurements and proper anterior and posterior segments examination. The other collected data included sex, age, site of IOL implantation, type of cataract, post-operative retinoscopy, and post-operative or intra-operative complications.

2.4. Statistical Analysis

The data were analyzed using SPSS software version 25.0 (SPSS, Inc.). Mean and standard deviation (SD) were used to describe IOP values. The continuous variables were studied with the Pearson correlation test. A paired sample t-test was used to find a difference in the pre and post-operative values of the same patient. A p-value of < 0.05 was considered

statistically significant.

3. RESULTS

Our study examined 20 children who underwent lensectomy surgery with IOL implantation due to congenital cataracts during the study period. Two patients were excluded as one did not attend scheduled visits at six months, and one child < 2 years old was left aphakic. Therefore, 18 children with 28 eyes were included in the study, with a mean age of 2.9 years ± 1.4. The result showed mean follow-up was 14 ± 1.82 months. Eight patients were reported with unilateral cataracts, while ten with bilateral cataracts. The pre-operative mean axial length was 18.92 ± 1.683 mm. Two eyes were presented with a large defect in the posterior capsule, and capsulorhexis was extended anteriorly and posteriorly in 5 and 2 eyes, respectively. In 4 eyes (14.3%), IOL and sulcus implantation was captured with haptics in the sulcus. Also, 24 eyes (85.7%) had IOL implanted in the bag. IOL of a 3-piece hydrophobic acrylic design was implanted in some patients (Sensar 3-piece IOL, Abbott Medical Optics, Inc.; or Hoya-PS AF-1 series, model PC-60AD, Hoya Corp.). Regarding post-operative evaluation, no eye reported retinal detachment, endophthalmitis, a shallow anterior chamber, or hyphema postoperatively. In contrast, 14 patients demonstrated twenty-seven post-operative complications. Among these, four eyes (14.2%) were with posterior synechiae, 2 (7.1%) with anterior synechiae, 3 (10.7%) with decentration of IOL, 8 (28.6%) with pigment on IOL, 3 (10.7%) with transient corneal oedema and 7 (25%) developed post-operative glaucoma (Fig. **1**). Post-operative glaucoma was developed in children at the follow-up of a mean of 8.2 ± 2.3 months. At the same time, one child reported transient ocular hypertension, requiring pharmacological management for only three months. At the last follow-up, five eyes (17.8%) in the bilateral cataract cases and one eye (3.6%) in the unilateral case developed anterior vitreous opacification requiring correction with a secondary procedure of membranectomy.

Our study examined change in IOP at three months interval post congenital cataract surgery, and results demonstrated an increase from the baseline value to the first follow-up visit at three months postoperatively. Then it declined with time at a six-month follow-up visit (Fig. **2**).

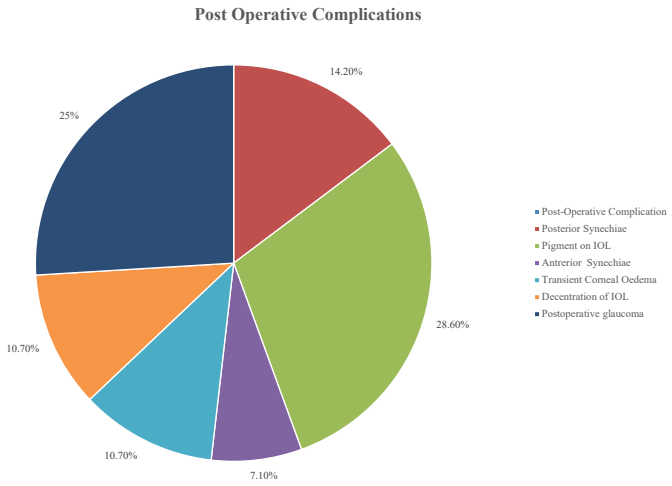

Fig. (1). Change in Intraocular pressure (IOP) values in mm Hg

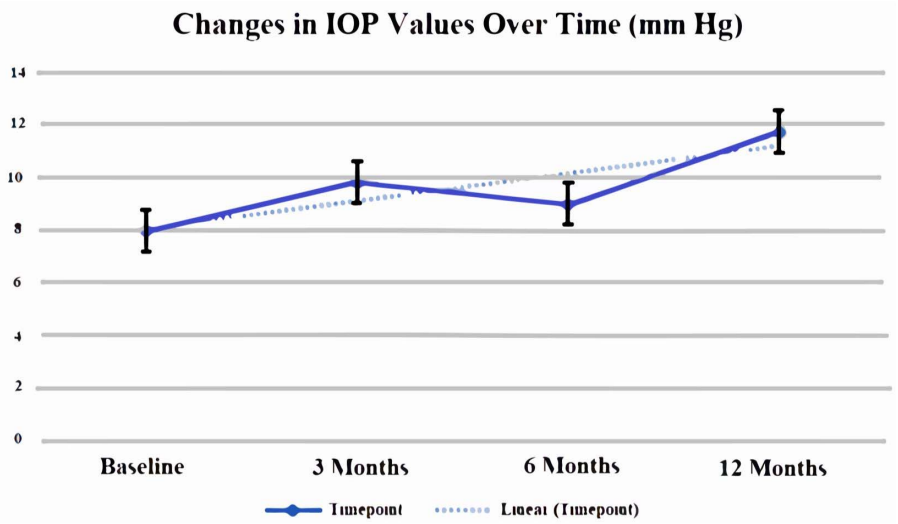

Fig. (2). Change in Intraocular pressure (IOP) values in mm Hg.

Table 1. Distribution of and change in IOP values at baseline and postoperative follow-ups.

IOP Exam	IOP (mm Hg)		95% CI of Difference		Change from baseline	P-value
	Mean ± SD	Range	Upper	Lower		
Baseline	7.98 ± 2.4	5, 13	8.95	6.78	-	-
At 3 months	9.82 ± 2.32	7, 19	10.82	9.98	+1.84	0.03*
At 6 months	9.0 ± 2.87	5, 11	9.26	8.85	+1.02	0.42
At 12 months	11.73 ± 2.6	7, 21	12.50	10.43	+3.75	0.001*

Note: IOP = intraocular pressure; CI = confidence interval; * = statistically significant

Table 2. Based on subgroup change in IOP values.

Variables		Increase in IOP from Baseline Mean ± SD	P-value
Age	-	-	0.88
-	<2 year	2.5± 1.22	-
-	≥2 years	3.8± 0.34	-
Sex	-	-	0.58
-	Female	2.21 ± 0.54	-
-	Male	3.43 ± 1.55	-
Site of IOL	-	-	0.3
-	In the bag	2.34 ± 1.77	-
-	Sulcus/captured	3.21 ± 1.73	-
Unilateral cataract	-	-	0.028*
-	Normal fellow eye	1.30 ± 1.01	-
-	Cataractous eye	4.42 ± 1.03	-
Postoperative fibrinous complication	-	-	0.43
-	Yes	3.49 ± 1.42	-
-	No	2.02 ± 0.43	-
Additional surgery needed	-	-	0.71
-	Yes	3.43 ± 2.61	-
-	No	3.92 ±2.01	-

Note: IOP = intraocular pressure; IOL = intraocular lens; SD = standard deviation; * = statistically significant

We examined the distribution of IOP and change in IOP values at baseline and post-operative follow-ups. Results showed statistically significantly higher IOP values at the third-month follow-up (P=0.03) and the last follow-up visit at 12 months (P=0.001) (Table **1**). A positive correlation was seen in IOP at one year (r Z 0.56, P Z .015). The IOP at baseline was also positively correlated (r Z 0.79, PZ .02). The unilateral cataract with their fellow normal eye showed no difference in their baseline IOP value (P Z .86). Also, baseline values of IOP showed no correlation with age (P Z .49).

Table **2** examined the changes in IOP values based on subgroups. The results showed higher IOP in boys, in cases with IOL located outside the bag, and in those children with more fibrinous complications. We observed a statistically significant increase from baseline in the IOP of the unilateral cataract eye compared to its normal fellow eye (P=0.028) (Table **2**). Children's visual acuity was assessed after IOL surgery using the Snellen chart and through the 'fix and follow' method, as some of them were too young to comply with the Snellen or any other equivalent acuity measurements. Statistical analysis suggested improved visual acuity after cataract removal in children with surgery at two years of age or later compared to younger children (P=0.001).

4. DISCUSSION

One of the major complications in pediatric cataract surgery is the susceptibility to glaucoma development, and IOP is its major predictive factor. This study aimed to assess the outcomes of congenital cataract surgery with IOL implantation in children aged one to five. In this study, the children at one-year follow-up showed a statistically significant increase in IOP after cataract extraction. Complications such as retinal detachment, endophthalmitis, a shallow anterior chamber, or hyphema were not reported postoperatively. At the same time, 14 patients had twenty-seven post-operative complications, such as posterior synechiae, anterior synechiae, IOL decentration, pigmentation on IOL, transient corneal oedema, and post-operative glaucoma. This study is novel as previous studies were on a smaller group of children with shorter follow-ups in Jordan or were conducted on older children [12, 15 - 18]. It is essential to have IOP evaluated postoperatively in congenital cataracts to interpret the surgery's outcomes accurately. Goldmann applanation tonometry is considered the gold standard to measure IOP in adults and children. However, with variations in CCT, the readings might be affected [19]. In the normative values, the central cornea at birth is thicker, rapidly decreasing in the initial months, then again increasing

and stabilizing. The mean values of IOP at baseline in our study were less than the average value of 10-13 mm Hg in children aged one to five years. However, according to the study of Jaafar and Kazi IOP in children is much lower than in adults (13.21 2.11 mm Hg in adults *versus* 4.55 0.51 mm Hg at age 0 to 1 year and 7.85 1.27 mm Hg by age 4 to 5 years).

Similarly, the values increased postoperatively compared to average values at twelve months. The study results are comparable to the previous research with one-year follow-up [10] and contradict the study by Faramarzi *et al*. [18] with six months of follow-up and observed significant differences in IOP values post-cataract surgery. This suggested that a longer follow-up is needed to establish a strong relationship between IOP and cataract surgery with IOL implantation.

Around 25% of the children developed glaucoma after surgery. The results of our study correlated with a previous study that suggested chronic glaucoma as a common outcome post-cataract surgery in children [19]. Furthermore, similar to this study, the study by Rabiah [20] stated that the average age of glaucoma occurrence was less than nine months. In these children, it was difficult to use the Snellen chart. Therefore the fix and follow method was used to check to understand. Similar to previous studies, the study found that age is an essential factor in cataract surgery [21]. The older children were comparatively fewer complications and better visual acuity than those younger than them. Children's assessment for visual acuity with the Snellen chart and 'fix and follow' method showed statistically improved visual acuity after cataract removal in children with surgery at two years of age or later than younger children (P=0.001). This implies that surgery after two years could be more successful in improving visual acuity post-cataract.

Association of Keratometry readings with more post-operative myopia suggested systematic biometric error [22]. It could be because of inaccuracies in the measurement process using the portable keratometer. However, there is no consensus on children's best IOL calculation formula. Although the data from the previous study [22, 23] suggested that using biometry is not always helpful, there is a need to continue performing biometry and refine a formula for children's eyes by acquiring more data.

As per the author's knowledge, this study is the first to relate the question of congenital cataract surgery with primary IOL implantation in children from one to five years in southern Jordan. This study was limited due to a lack of controls and a small sample size. Further studies with randomized control trials are suggested for more generalizability of outcomes of pediatric cataract surgery.

CONCLUSION

In southern Jordan, a growing locale for dealing with problems from cataract surgery, the study was designed to evaluate the results of congenital cataract surgery with IOL implantation. While the kind of surgery used to treat a child's congenital cataract did not affect the child's final visual acuity. It also concluded that post-operative follow-up of one year in paediatric patients treated with congenital cataract surgery showed a significant increase in intraocular pressure. Certain surgical factors may lead to an increase in IOP through the interruption of the normal development of the cornea and the trabecular meshwork. Therefore, a randomized prospective study with a longer follow-up duration is required to assess the outcomes of paediatric cataract surgery and develop evidence-based IOP management guidelines for paediatric patients after congenital cataract surgery.

LIST OF ABBREVIATIONS

B-scan	=	Brightness Modulation Ultrasound
CCT	=	Central Corneal Thickness
CI	=	Confidence Interval
GA	=	General Anesthesia
IOL	=	Intraocular Lens
IOP	=	Intraocular Pressure
SD	=	Standard Deviation

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was initiated after approval from the ethics committee of the World Medical Association to protect human subjects.

HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are the basis of this research. All the humans were used per the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013 (http://ethics.iit.edu/ecodes/node/3931).

CONSENT FOR PUBLICATION

All the study participants signed a written consent form before the study's commencement.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and analyzed during the current study are available from the corresponding author [K.A-Z] upon request.

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CONFLICTS OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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