DOI: 10.7860/JCDR/2022/52927.16451

Original Article

Ophthalmology Section

Early Cataract and Surgical Recovery in Young Type 1 Diabetics: Experiences from a Single Centre in Northern India

RISHI SHUKLA[1], SANGEETA SHUKLA[2], NEHA AGARWAL[3], ANURAG BAJPAI[4], MOHIT KHATTRI[5]

ABSTRACT

Introduction: Cataract, a non retinal ophthalmic complication, is the leading cause of visual impairment in adults living with Type 1 Diabetes (T1D). Unfortunately, there is a dearth of data on diabetic cataract in the paediatric population, particularly from developing countries. To the best of authors' knowledge, the current study is the first and the largest observational study reporting the characteristics, and surgical recovery of early cataract among Indian children and adolescents living with T1D.

Aim: To report the patient characteristics and surgical outcome of early cataract in young type 1 diabetics.

Materials and Methods: The present study was a retrospective observational study (January 2005-December 2020), conducted at Regency Hospital Pvt. Ltd., Kanpur, Uttar Pradesh, India. Medical records of children and adolescents (n=150) aged 1-18 years with T1D in the last 15 years, and who developed cataract during follow-up were included in the study and reviewed from January 2021 to March 2021, for the socio-demographic details, age at which diabetes was diagnosed, presence or absence of ketoacidosis at the time of diagnosis of diabetes, age at which cataract was diagnosed, glycaemic control, morphology and laterality of cataract, history of retinopathy before cataract surgery, presence or absence of concomitant nephropathy, visual acuity at the time of cataract diagnosis, type of surgical intervention done and visual acuity following surgery.

Results: Out of 150 T1D patients, a total of 10 patients (five boys; 19 eyes) were diagnosed with cataract, before the age of 18 years. The mean age at diagnosis of T1D was 8.6±3.2 years (range 3-12 years) and cataract was 13.2±4.1 years (range, 6-18 years). Mean HbA1c at the time of cataract diagnosis was 7.99±0.98%. The past history of diabetic ketoacidosis was documented in patients (60%). Nearly 70% (n=7) patients belonged to the lower socio-economic strata. Cortical cataract (12/19 eyes; 63%) was the most common morphology identified. These patients were operated after a mean duration of 0.5±0.7 years of cataract diagnosis. The corrected visual acuity remained good after a mean follow-up duration of 3.2±2.7 years (range 0-8 years), post cataract extraction.

Conclusion: The experiences gained from the present study reinforce the need for early cataract screening in the paediatric diabetic population, especially in those, belonging to lower socio-economic strata, and/or with history of diabetic ketoacidosis. Cortical cataract was the most common form identified. Vision can be preserved with timely surgical intervention.

Keywords: Cataract surgery, Cortical cataract, Diabetic ketoacidosis, Paediatric diabetes

INTRODUCTION

Type 1 diabetes (T1D) and its associated complications is one of the leading public health problems contributing to morbidity and mortality, later in life. Cataract, retinopathy, strabismus, glaucoma, refractive changes, macular oedema, and papillopathy are some of the ocular complications, known to be associated with diabetes [1,2]. Cataract, a non retinal ophthalmic complication, is a known leading cause of visual impairment in adults with T1D. Unfortunately, only limited data in the form of case reports are available that describe early diabetic cataract and its outcomes among children and adolescents [3].

Based on the limited data available, diabetic cataract is believed to occur more frequently in those with a longer duration of symptoms prior to the diagnosis of diabetes, or in those with poor metabolic control [4]. However, since all children and adolescents with T1D do not develop cataract, other factors, such as genetic predisposition, nutrition, and the use of offending drugs (e.g., steroids) might also be considered in the pathogenesis of early diabetic cataract [4]. Despite, being an important preventable cause of permanent visual impairment, definite recommendations for the screening of early diabetic cataract in children and adolescents living with diabetes is lacking [5,6].

Although surgical intervention remains the gold standard for the management of cataract [7], it is not without complications. Apart from acute complications like incision leakage, oedema, increased intraocular pressure, and uveitis; other common complications associated with cataract surgery include, Posterior Capsular Opacification (PCO), secondary glaucoma, retinal detachment, and amblyopia [8]. Long-term T1D and growth and development of the anterior eye chamber accounts for the occurrence of these complications [9]. Extended follow-up of patients is, therefore, advocated to understand the possible influence of surgery on ophthalmologic complications. However, majority of this data is available from developed countries [3], whose findings cannot be extrapolated to the developing nations.

To the best of the author's knowledge, this is the first and the largest study reporting the characteristics, and surgical recovery of early cataract among Indian children and adolescents living with T1D.

MATERIALS AND METHODS

This retrospective observational study was conducted jointly by the departments of Endocrinology and Ophthalmology of a tertiary care multi-specialty hospital (Regency Hospital Pvt. Ltd., Kanpur) in northern India. Medical records from January 2005 till December 2020 were retrieved. Data collection and analysis was done over a period of three months, extending from January 2021 to March 2021.

Inclusion and Exclusion criteria: Records of children and adolescents (n=150) aged 1-18 years with type 1 diabetes, and who developed cataract during follow-up were included in the study. Those with incomplete medical records, type 1 diagnosis after 18 years of age, and/or pre-existing cataract were excluded from the study.

Study Procedure

Records of subjects were reviewed for the socio-demographic details, age at which diabetes was diagnosed, presence or absence of ketoacidosis at the time of diagnosis of diabetes, age at which cataract was diagnosed, glycaemic control, morphology and laterality of cataract, history of retinopathy before cataract surgery, presence or absence of concomitant nephropathy, visual acuity at the time of cataract diagnosis, type of surgical intervention done, and visual acuity following surgery.

The mean of previous three readings of glycosylated haemoglobin (HbA1C) done over the last one year were recorded at the time of diagnosis of cataract for the assessment of glycaemic control. Glycaemic control was defined as good or poor, based on the HbA1C level of less than or more than 7.5, respectively [10]. Nephropathy was diagnosed based on the result of spot urine Albumin Creatinine Ratio (ACR) [10]. Ophthalmologic evaluation was done by two experts in the field of ophthalmology with fundus photographs, and Snellen's chart was used for visual acuity assessment. Ethical clearance was waived off.

STATISTICAL ANALYSIS

The data was compiled using Microsoft Excel and descriptive data was presented.

RESULTS

Out of 150 T1D patient's pool, a total of 10 (five boys) patients were diagnosed with cataract before the age of 18 years. Remaining 140 patients (who did not develop cataract) were excluded from the analyses. The mean age at the diagnosis of T1D was 8.6±3.2 years (range 3-12 years) and the mean age at the diagnosis of cataract was 13.2±4.1 years (range 6-18 years). The mean interval between the two was 4.6±1.8 years (range 2-8 years). Mean HbA1C at the time of cataract diagnosis was 7.99±0.98%. Nearly 70% (n=7) patients belonged to the lower socio-economic status as per the modified kuppuswamy classification [11]. A past history of diabetic ketoacidosis was documented in six patients; two patients had concomitant nephropathy while none of them had diabetic retinopathy.

Among these, only one patient had unilateral cataract (OD, right eye cataract) while the other nine patients had bilateral cataract (OU). These patients underwent cataract extraction after a mean duration of 0.5±0.7 years of cataract diagnosis, and were followed-up for a mean duration of 3.2±2.7 years (range 0-8 years), post cataract extraction. The clinical characteristics of all the ten patients are summarised in [Table/Fig-1]. Cortical cataract (12/19 eyes; 63%) was the most common morphology identified, followed by posterior polar (5/19 eyes; 26.3%) and hyper-mature cataract (2/19 eyes; 10.5%).

Phacoemulsification (PE) was done in five patients (10 eyes), small-incision cataract surgery in four patients (seven eyes), and micro-incision cataract surgery in one patient (two eyes). Implantation of Intra-ocular Lens (IOL) was performed in all the patients (rigid poly methyl methacrylate in two, foldable hydrophilic in six, foldable hydrophobic in seven, heparin-coated in two and multi-focal in two eyes). No intraoperative or immediate post-operative complication was observed.

Following surgery, improvement in the visual acuity was seen in 1-2 weeks. The best corrected visual acuity was 6/6 or 6/6 (partial) in all patients except one (patient 3), as this patient was amblyopic preoperatively (V/A 6/24, left eye amblyopia). Visual acuity remained good after a mean follow-up duration of 3.2±2.7 years (range 0 to 8 years), post cataract surgery. One patient (patient 5) showed a decline in visual acuity which was attributed to the development of non proliferative diabetic retinopathy in the peri-macular area. Three patients developed non proliferative retinopathy during follow-up, after a mean diabetes duration of 8.9±1.3 years (7-10 years). The PCO was not observed in patients who underwent hydrophobic,

Variables	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9	Patient 10
Gender	Female	Female	Male	Female	Male	Male	Male	Female	Male	Female
Age at T1D diagnosis (y)	7	3	10	10	8	4	12	12	8	12
DKA at T1D diagnosis	Yes	No	Yes	Yes	No	Yes	No	Yes	No	Yes
Age at cataract diagnosis (y)	14	6	15	18	12	7	17	17	12	14
HbA1C (%) at cataract diagnosis	7.4	7.8	7.9	7.7	6.7	8.8	8.6	6.8	8.2	10
Best corrected V/A at diagnosis	6/36 (OD) 6/24 (OS)	6/60 (OD) 1/60 (OS)	6/24 (OD)	6/24 (OD) 6/24 (OS)	6/24 (OD) 6/24 (OS)	6/60 (OD) 6/24 (OS)	6/8 (OD) 6/18 (OS)	6/12 (OD) 6/2 (OS)	6/18 (OD) 6/18 (OS)	6/60 (OD) 6/36 (OS)
Co-existing nephropathy	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
Laterality	OU	OU	OD	OU	OU	OU	OU	OU	OU	OU
Cataract morphology	Cortical	Cortical	Posterior polar	Cortical	Posterior polar	Cortical	Cortical	Posterior polar	Cortical	White cataract
Age at CS (y)	14	6	16	18	12	9	17	18	12	15
Pre-op DR	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Surgery done	SICS	PE	SICS	PE	PE	PE	SICS	MICS	SICS	PE
Best corrected V/A at 2 weeks	6/6	6/6	6/24, left eye amblyopia	6/6	6/6	6/6	6/6	6/6	6/6	6/6
IOL type	Rigid	Hydrophilic	Hydrophobic	Hydrophilic	Hydrophobic	Heparin coated	Hydrophobic	Multifocal	Hydrophilic	Hydrophobic
Nd-YAG capsulotomy	Done	Done	Not done	Done	Not done	Not done	Not done	Not done	Done	Not done
F/U duration (y)	8	1	2	6	3	0	5	0	5	2
Best corrected V/A at last visit	6/6	6/6	6/18	6/6	6/12	6/6	6/6	6/6	6/6	6/6
Postoperative NPDR	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Present	Absent
PCO	Present	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent

[Table/Fig-1]: Clinical, surgical and follow-up data of young patients with Type-1 Diabetes and cataract.
CS: Cataract surgery; DKA: Diabetic ketoacidosis; DR: Diabetic retinopathy; F/U: Follow-up; HbA1C: Glycated haemoglobin; IOL: Intra-ocular lens; V/A: Visual acuity; MICS: Minimal incision cataract surgery; Nd-YAG: Neodymium-doped yttrium aluminium garnet; NPDR: Non-proliferative diabetic retinopathy; PE: Phacoemulsification; PCO: Posterior capsular opacification

heparin-coated and multi-focal IOL implantation. The Nd:YAG capsulotomy was performed in the eight eyes that developed PCO.

DISCUSSION

Cataract is an important preventable cause of visual impairment among those living with T1D [1,2]. Past studies have reported variable relationship between the glycaemic control and development of cataract. García E and García Robles E have reported cataract development in patients with strictly controlled blood glucose levels [3]. Exact pathogenesis and risk factors for the cataract development in diabetic patients is still unclear.

Findings of the present study highlight that cataract formation is not an uncommon complication of T1D in the paediatric population. Unfortunately, no clear recommendations exist regarding cataract screening in the paediatric diabetic population. The diagnosis of T1D and cataract are both very important for school going children.

Interestingly, the majority of the patients had a history of ketoacidosis at the time of diabetes diagnosis, and/or belonged to lower socio-economic status. Since 70% (n=7) of the patients belonged to the poor socio-economic strata, lack of good nutrition could be a plausible explanation. Being an indirect evidence, this needs further exploration in future studies. Further, six of the study patients had diabetic ketoacidosis at the time of diagnosis of T1D. Extreme high blood sugar and ketoacidosis at the time of diabetes presentation might play a role in the development of early cataract in the present study patients. The association between cataract and ketoacidosis has been reported in the past [12]. This highlights the importance of cataract screening in individuals presenting with a high HbA1C level and diabetic ketoacidosis.

Previous studies report significant variability in the level of HbA1C, both at the time of diagnosis of T1D and diabetic cataract [2,4]. Importantly, majority of the patients had optimal metabolic control (7.5% to 8.5%), with only 3 patients having HbA1C more than 8.5% at the time of diagnosis of cataract. This highlights the role of factors like the time in range, genetic predisposition, and nutrition in the development of early diabetic cataract. Data regarding time in range were not available for the present study patients and hence, could not be reported.

Similar to a previous report by Iafusco D et al., [12], an equal gender distribution was observed in the present study. In contradiction to this, a few authors have reported female preponderance in their studies [13,14]. Most patients with early diabetic cataract reported in the literature were adolescents [15], with the youngest case being reported in a 5-year-old patient [16].

In the present study, there was a mean interval of 4.6±1.8 years between the diagnosis of diabetes and the detection of cataract. However, cataract has been reported to occur as early as six months after the onset of diabetes and in a few instances, is even the first sign of T1D [17]. Ehrlich RM et al., emphasised that T1D should be considered in all children with acquired cataract of unknown aetiology [18].

As far as the morphology is concerned, posterior sub-capsular cataract is reported to be the most common type of diabetic cataract in the paediatric population [18,19]. In contrast to this, the authors observed cortical cataract to be the most common type in the present study patients.

The type of surgical technique employed depends on the age of the patient. Phacoemulsification is preferred in older children and adults while it is not mandatory in younger children owing to soft cataract [7]. Similar to the trend observed in developed countries, phacoemulsification was the most common technique used in the present study. Nevertheless, cataract surgery is not without complications. In addition, long standing T1D and growth and development of anterior eye segment, further increases the risk of complications [8,9]. The authors found development of PCO in 8 eyes (40%), which is much lower than that reported in a study by Piluek WJ and Fredrick D, who noted PCO in up to 90% of paediatric cataract patients [20]. Moreover, onset and progression of retinopathy is reported to be influenced by cataract surgery [1,19]. Falck A and Laatikainen L observed retinopathy in eight out of 11 eyes in paediatric patients who underwent surgery for early diabetic cataract [16]. The authors also observed mild non-diabetic proliferative retinopathy in three patients (8/19 eyes, 42.10%) not at the time of surgery, but after a mean diabetes duration of 8.9±1.3 years (7-10 years). Consequently, long-term follow-up is needed to explore the possible impact of surgical interventions on the development of ocular complications.

Limitation(s)

The retrospective study design constitutes a limitation of the present study. However, meticulous record maintenance and protocolised management of the patients by the same clinical leads throughout the study period ascertained the availability and reliability of the data. Studies with a long-term follow-up are needed to observe the complications developed after the surgery.

CONCLUSION(S)

Cortical cataract was the most common form identified in the present study. There is a need for early cataract screening in the paediatric diabetic population, especially in those, belonging to lower socio-economic strata, and/or with history of diabetic ketoacidosis. With timely surgical intervention, vision can be preserved.

REFERENCES

[1] Sayin N, Kara N, Pekel G. Ocular complications of diabetes mellitus. World Journal of Diabetes. 2015;6:92.
[2] Geloneck MM, Forbes BJ, Shaffer J, Ying GS, Binenbaum G. Ocular Complications in Children with Diabetes Mellitus. Ophthalmology. 2015;122:2457-64.
[3] García E, García Robles E. Cataract: A forgotten early complication of diabetes in children and adolescents. Endocrinol Diabetes Nutr. 2017;64:58-59.
[4] Montgomery EL, Batch JA. Cataracts in insulin-dependent diabetes mellitus: sixteen years' experience in children and adolescents. J Paediatr Child Health. 1998;34:179-82.
[5] Donaghue KC, Marcovecchio ML, Wadwa RP, Chew EY, Wong TY, Calliari LE, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Microvascular and macrovascular complications in children and adolescents. Pediatr Diabetes. 2018;19:262-74.
[6] American Diabetes Association. Standards of Medical Care in Diabetes-2019 Abridged for Primary Care Providers. Clin Diabetes. 2019;37:11-34.
[7] de Silva SR, Riaz Y, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. Cochrane Database Syst Rev. 2014;(1):CD008812.
[8] Gasper C, Trivedi RH, Wilson ME. Complications of Pediatric Cataract Surgery. Dev Ophthalmol. 2016;57:69-84.
[9] Chen D, Gong XH, Xie H, Zhu XN, Li J, Zhao YE. The long-term anterior segment configuration after pediatric cataract surgery and the association with secondary glaucoma. Scientific reports. 2017;7:01-09.
[10] American Diabetes Association. 6. Glycemic Targets: Standards of Medical Care in Diabetes-2020. Diabetes Care. 2020;43(Suppl 1):S66-S76.
[11] Mishra D, Singh HP. Kuppuswamy's socioeconomic status scale—A revision. Indian J Pediatr. 2003;70:273-74.
[12] Iafusco D, Prisco F, Romano MR, Dell'omo R, Libondi T, Costagliola C. Acute juvenile cataract in newly diagnosed type 1 diabetic patients: A description of six cases. Pediatr Diabetes. 2011;12:642-48.
[13] Wilson Jr ME, Levin AV, Trivedi RH, Kruger SJ, Elliott LA, Ainsworth JR, et al. Cataract associated with type-1 diabetes mellitus in the pediatric population. Journal of American Association for Pediatric Ophthalmology and Strabismus. 2007;11:162-65.
[14] Šimunović M, Paradžik M, Škrabić R, Unić I, Bućan K, Škrabić V. Cataract as early ocular complication in children and adolescents with type 1 diabetes mellitus. Int J Endocrinol. 2018;2018:6763586. Doi: 10.1155/2018/6763586.
[15] Datta V, Swift PG, Woodruff GH, Harris RF. Metabolic cataracts in newly diagnosed diabetes. Archives of disease in childhood. 1997;76:118-20.
[16] Falck A, Laatikainen L. Diabetic cataract in children. Acta Ophthalmol Scand. 1998;76:238-40.

[17] Scarpitta AM, Perrone P, Sinagra D. The diabetic cataract: An unusual presentation in a young subject: Case report. J Diabetes Complications. 1997;11:259-60.
[18] Ehrlich RM, Kirsch S, Daneman D. Cataracts in children with diabetes mellitus. Diabetes Care. 1987;10:798-99.
[19] Patel CM, Plummer-Smith L, Ugrasbul F. Bilateral metabolic cataracts in 10-yr-old boy with newly diagnosed type 1 diabetes mellitus. Pediatr Diabetes. 2009;10:227-29.
[20] Piluek WJ, Fredrick D. Posterior Capsule Management in Pediatric Cataract Surgery. Investigative Ophthalmology & Visual Science. 2013;54:2993.

PARTICULARS OF CONTRIBUTORS:
1. Consultant, Department of Endocrinology, Regency Hospital, Kanpur, Uttar Pradesh, India.
2. Consultant, Department of Ophthalmology, Regency Hospital, Kanpur, Uttar Pradesh, India.
3. Assistant Professor, Department of Paediatrics, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India.
4. Consultant, Department of Endocrinology, Regency Hospital, Kanpur, Uttar Pradesh, India.
5. Consultant, Department of Ophthalmology, Regency Hospital, Kanpur, Uttar Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Neha Agarwal,
House No. 264, Lane No. 17, Golden Green Park Colony, Bareilly, Uttar Pradesh, India.
E-mail: nagarwal88@yahoo.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 21, 2021
- Manual Googling: Dec 14, 2021
- iThenticate Software: Jan 31, 2022 (8%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Oct 19, 2021**
Date of Peer Review: **Dec 15, 2021**
Date of Acceptance: **Feb 01, 2022**
Date of Publishing: **Jun 01, 2022**