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CASE REPORT

Beyond Hyperglycemia: Bilateral Total Cataract in an Adolescent with Type 1 Diabetes Mellitus

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Abstract

Cataracts in children and adolescents with type 1 diabetes mellitus (T1DM) are uncommon but can cause profound visual impairment. This case report describes the clinical presentation, surgical management, and short-term outcomes of bilateral total cataracts in a 16-year-old female with an approximately two-year history of T1DM. Clinical data were retrospectively obtained from medical records, including ophthalmologic examinations, ocular biometry, operative reports, and postoperative assessments. At presentation, visual acuity was limited to hand movements in both eyes, and dense lens opacities prevented fundus visualization. The patient underwent sequential bilateral cataract extraction with posterior chamber intraocular lens implantation under general anesthesia. Uncorrected visual acuity improved to 6/6 in each eye during the first postoperative week and remained 6/6 at the one-month follow-up for each eye. This case highlights the potential for substantial visual recovery following surgery in an adolescent with bilateral total cataracts and T1DM. Although diabetes may have contributed to cataract formation, the available clinical information does not establish a causal relationship. Continued diabetes management and individualized ophthalmic follow-up remain important for long-term ocular health.

Introduction

Cataract in children and adolescents with type 1 diabetes mellitus (T1DM) is uncommon but clinically important because it can cause substantial visual impairment and may require surgical intervention. Chronic hyperglycemia may contribute to lens opacification through several mechanisms, including sorbitol accumulation via the polyol pathway, oxidative stress, and the formation of advanced glycation end products, which can alter lens transparency. Šimunović et al. [1] reported prevalence estimates of 0.7% to 3.4% for early diabetic cataract across previously published studies. In a large observational study using data from the German–Austrian Diabetes Prospective Follow-up (DPV) registry, Reiter et al. [2] identified cataracts in 235 of 92,633 patients aged 0.5 to 21 years with T1DM, corresponding to 0.25% of the study population. Among these patients, 67 were classified as having early cataracts, 133 as having late cataracts, and 35 had no available information on the timing of cataract diagnosis. Differences in study populations and diagnostic definitions should be considered when interpreting these estimates.

Previous case reports have described bilateral cataracts in young patients with T1DM. Boiro et al. [3], for example, reported an 18-year-old girl with a six-year history of T1DM and poor glycemic control, whose visual acuity improved to 8/10 in both eyes following sequential cataract surgery. These reports demonstrate that substantial visual impairment associated with cataracts can occur in young patients with T1DM and that surgical treatment may improve visual acuity. However, individual case reports cannot establish that diabetes is the sole cause of cataract formation. Furthermore, dense cataracts may prevent adequate preoperative

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visualization of the fundus, limiting assessment of the underlying retinal status in patients who are also at risk of diabetes-related ocular complications. Detailed descriptions of the clinical presentation, surgical management, and postoperative outcomes of such cases remain useful for clinical understanding, particularly when the available information does not establish a definitive etiology.

This report aims to describe the clinical presentation, sequential surgical management, and short-term visual outcomes of bilateral total cataracts in a 16-year-old adolescent with an approximately two-year documented history of T1DM, while discussing the challenges of etiological attribution and the importance of postoperative ophthalmic assessment.

Materials and Methods

Study Design and Patient Information

This retrospective case report describes the clinical presentation, surgical management, and postoperative outcomes of a 16-year-old female adolescent with bilateral total cataracts and a history of T1DM. Clinical information was retrieved from the patient's medical records, including medical history, ophthalmologic examinations, preoperative ocular biometry, operative reports, postoperative assessments, and follow-up findings. The observation period began at the initial ophthalmologic consultation, designated as Day 0, and continued through sequential bilateral cataract surgery and postoperative follow-up. The clinical course and documented outcomes were summarized descriptively.

Clinical Assessment and Surgical Management

At the initial ophthalmologic assessment, preoperative visual acuity was documented as hand movements (HM) in both eyes. Anterior segment examination included assessment of the conjunctiva, cornea, iris, pupils, and lens. Bilateral total cataracts were identified, and dense lens opacities prevented adequate visualization of the posterior segments before surgery.

Preoperative ocular biometry was performed using an AL-100 biometer. The recorded parameters included axial length, anterior chamber depth, and keratometry values (K1 and K2) for each eye. Intraocular lens (IOL) power was calculated using the SRK/T formula. The selected IOL powers were 25.50 diopters (D) for the right eye and 27.00 D for the left eye.

The patient underwent sequential bilateral cataract extraction with posterior chamber IOL implantation under general anesthesia because she was unable to cooperate adequately with surgery under local anesthesia. The left eye was operated on first on Day 5, followed by the right eye on Day 40, resulting in an interval of 35 days between procedures. The specific clinical rationale for this interval was not documented in the available medical records.

According to the operative reports, each procedure began with anterior capsule staining using trypan blue, followed by continuous curvilinear capsulorhexis. Lens material was then removed using a Simcoe cannula, and a posterior chamber IOL was implanted. The operative records documented an intact posterior capsule at the end of the procedure and closure of the surgical wounds with sutures. Further technical details, including the trypan blue concentration, capsulorhexis diameter, irrigation and aspiration settings, IOL model, incision dimensions, and suture type, were not available in the records reviewed and are therefore not specified.

Outcome Assessment

The primary outcome was visual acuity before and after surgery. Secondary outcomes included intraocular pressure (IOP), anterior segment findings, IOL position, fundus examination findings, and documented postoperative complications. Postoperative assessments were reviewed for each eye separately during the first postoperative week and at the documented one-month follow-up after that eye's surgery.

At the first postoperative week, uncorrected visual acuity (UCVA), IOP, and documented fundus findings were recorded. At the one-month follow-up for each eye, UCVA and the documented clinical status were reviewed. Findings were extracted from the available medical records and summarized descriptively. No additional examinations or measurements were inferred when they were not documented.

Results and Discussion

Clinical Presentation and Preoperative Evaluation

A 16-year-old female adolescent with an approximately two-year history of T1DM, diagnosed at the age of 14 years, presented to the ophthalmology department with severe bilateral visual impairment. At the initial ophthalmologic consultation (Day 0), visual acuity was documented as hand movements (HM) in both eyes.

Anterior segment examination revealed clear conjunctivae and corneas, normal iris configuration, and round pupils with positive light reflexes. Both lenses were totally opaque, consistent with bilateral total cataracts. The dense lens opacities prevented adequate visualization of the posterior segments before surgery.

The patient was hospitalized for perioperative management related to general anesthesia, including preanesthetic medication and postoperative monitoring. Her glycated hemoglobin (HbA1c) level was 11% during a previous hospitalization. At an outpatient follow-up approximately three months after discharge, HbA1c had decreased to 6%. Her diabetes treatment included insulin glargine (Lantus SoloStar). These measurements represent glycemic control at two different time points and do not establish glycemic exposure at cataract onset.

Preoperative ocular biometry was performed using an AL-100 biometer, and IOL power was calculated using the SRK/T formula. The right eye had an axial length of 21.39 mm, an anterior chamber depth of 6.92 mm, keratometry values of 45.00 D for K1 and 45.12 D for K2, and a calculated IOL power of 25.50 D. The left eye had an axial length of 21.53 mm, an anterior chamber depth of 6.99 mm, keratometry values of 42.88 D for K1 and 43.00 D for K2, and a calculated IOL power of 27.00 D. The biometric measurements and calculated IOL powers are summarized in Table 1.

Table 1. Preoperative ocular biometry and intraocular lens power calculation.

Parameter	Right eye (OD)	Left eye (OS)
Axial length (mm)	21.39	21.53
Anterior chamber depth (mm)	6.92	6.99
Keratometry K1 (D)	45.00	42.88
Keratometry K2 (D)	45.12	43.00
Calculated IOL power (D)	25.50	27.00

The clinical timeline, including the initial assessment, sequential surgical procedures, and postoperative outcomes for each eye, is presented in Table 2.

Table 2. Clinical timeline and visual outcomes.

Time point	Clinical findings or intervention	Visual acuity
16 July 2026	Initial ophthalmology consultation; bilateral total cataract	1/300 OU
21 July 2026	Left-eye lensectomy and posterior chamber IOL implantation under general anesthesia	6/6 on postoperative day 1
25/08/2026	Right-eye lensectomy and posterior chamber IOL implantation under general anesthesia	6/6 on postoperative day 1
One-month postoperative follow-up	Stable bilateral pseudophakia; near-vision spectacles prescribed	6/6 OU

Abbreviations: IOL, intraocular lens; OU, both eyes.

Surgical Management

Cataract surgery was performed on the left eye on Day 5 under general anesthesia because the patient was unable to cooperate adequately with surgery under local anesthesia. According to the operative record, the anterior capsule was stained with trypan blue, followed by continuous curvilinear capsulorhexis. Lens material was removed using a Simcoe cannula, and a posterior chamber IOL was implanted. The posterior capsule remained intact, and the surgical wound was secured with sutures.

The right eye underwent the same documented surgical procedure on Day 40, 35 days after the left-eye operation. The procedure was also performed under general anesthesia. The posterior capsule remained intact, and the surgical wound was secured with sutures. The specific clinical rationale for the interval between the two procedures was not established in the available documentation.

Postoperative Outcome

During the first postoperative week following each procedure, UCVA was documented as 6/6 in the operated eye. IOP was 18 mmHg in the left eye and 16 mmHg in the right eye at their respective postoperative assessments.

Fundus examination documented round optic discs with well-defined margins, a cup-to-disc ratio of 0.3, flat retinas, and positive foveal reflexes. These findings were recorded after cataract removal permitted visualization of the posterior segments.

At the documented one-month postoperative follow-up for each eye, UCVA remained 6/6, and both eyes were documented as having stable pseudophakia. Near-vision spectacles were prescribed. The available records did not establish that IOP and fundus examinations were repeated at the one-month visits.

Pediatric Cataract Associated with Type 1 Diabetes Mellitus

Cataract in children and adolescents with T1DM is uncommon but clinically important because it can cause substantial visual impairment. Šimunović et al. [1] reported prevalence estimates of 0.7% to 3.4% for early diabetic cataract across previously published studies and noted that many reported cases developed around the onset of diabetes or within approximately six months. In a large observational analysis of the German–Austrian DPV registry, Reiter et al. [2] identified cataracts in 235 of 92,633 individuals with T1DM aged 0.5 to 21 years, corresponding to 0.25% of the cohort. Of these patients, 67 were classified as having early cataracts, 133 as having late cataracts, and 35 had no available information regarding the timing of diagnosis.

In the present case, bilateral total cataracts were identified in an adolescent with an approximately two-year documented history of T1DM. This interval places the diagnosis beyond the early-cataract time window used by Reiter et al. [2]. However, the exact onset and rate of progression of the cataracts were not documented. The time of diagnosis should therefore not be assumed to represent the time of onset. The severity of the lens opacities and the profound visual impairment at presentation describe the clinical condition but do not establish its underlying cause.

Boiro et al. [3] described an 18-year-old girl with a six-year history of T1DM and poor glycemic control, with a mean HbA1c level of 10.6% during the preceding year. Her visual acuity improved to 8/10 in both eyes following sequential cataract surgery. Both that report and the present case demonstrate that substantial visual impairment associated with bilateral cataracts can occur in young patients with T1DM and that surgery may improve visual function. Nevertheless, individual case reports cannot establish diabetes as the sole cause of cataract formation.

Potential Pathophysiological Mechanisms and Differential Etiology

Hyperglycemia has been implicated in diabetic cataract formation through several proposed mechanisms. Glucose entering the lens can be converted to sorbitol through the polyol pathway. Intracellular sorbitol accumulation may increase osmotic stress, while altered redox balance, oxidative stress, and the formation of advanced glycation end products may contribute to lens protein modification and loss of transparency [1,4,5]. These mechanisms provide biological plausibility for an association between T1DM and cataract formation, but they were not directly assessed in this patient.

Other causes of juvenile cataract must also be considered. The available history indicated no family history of cataract and no corticosteroid exposure. However, a comprehensive etiological evaluation was not available in the documented information, so other metabolic, developmental, or systemic causes cannot be fully excluded.

The measured axial lengths were 21.39 mm in the right eye and 21.53 mm in the left eye. These values are relatively short compared with typical adult axial lengths and warrant cautious interpretation in the context of ocular development. However, axial length alone is insufficient to diagnose microphthalmos or establish a developmental cause. The biometric measurements should therefore be interpreted as clinical observations rather than evidence of a specific underlying disorder.

Accordingly, the case is best described as bilateral total cataracts in an adolescent with T1DM rather than as cataracts definitively caused by diabetes. This distinction is important because the clinical association is documented, whereas the causal relationship remains uncertain.

Glycemic Control and Cataract Development

The relationship between glycemic exposure and cataract development is relevant in pediatric T1DM. In the DPV registry study, patients with cataract showed evidence of greater glycemic exposure in several analyses, including higher mean HbA1c levels among patients with late cataract than in the reference group [2]. These findings support a possible contribution of hyperglycemia to cataract development at the population level, although they cannot establish causality in an individual patient.

In the present case, HbA1c was 11% during a previous hospitalization and decreased to 6% at an outpatient assessment approximately three months after discharge. The patient's diabetes treatment included insulin glargine. These measurements indicate a change in glycemic control between the two assessment points, but they do not establish cumulative glycemic exposure before cataract formation. The occurrence of cataracts should therefore not be interpreted as direct evidence of inadequate glycemic control at the time of ophthalmologic presentation.

Longitudinal assessment of glycemic control, including HbA1c and blood glucose monitoring, remains important in the management of children and adolescents with T1DM. The American Diabetes Association Professional Practice Committee for Diabetes recommends an HbA1c target below 7% for many children and adolescents when it can be achieved safely, with individualization according to clinical circumstances [6]. In this patient, the decrease in HbA1c is a relevant clinical observation, but the available measurements are insufficient to characterize glycemic exposure over the period preceding cataract development.

Surgical Management and Visual Outcome

Cataract surgery was indicated because bilateral total lens opacities were associated with profound visual impairment. The patient underwent sequential cataract extraction with posterior chamber IOL implantation under general anesthesia because she was unable to cooperate adequately with surgery under local anesthesia. The left eye was operated on first,

followed by the right eye 35 days later. The available documentation did not establish the specific clinical rationale for this interval.

Both procedures involved trypan blue staining of the anterior capsule, continuous curvilinear capsulorhexis, removal of lens material using a Simcoe cannula, and posterior chamber IOL implantation. The posterior capsule remained intact, and the surgical wounds were secured with sutures. The absence of a documented posterior capsule rupture is a relevant operative finding, although the available records do not provide enough detail to characterize all intraoperative parameters or complications beyond those explicitly recorded.

UCVA improved to 6/6 in each operated eye during the first postoperative week and remained 6/6 at the documented one-month follow-up for each eye. IOP was 18 mmHg in the left eye and 16 mmHg in the right eye at the respective first-week assessments. Postoperative fundus examinations documented round optic discs with well-defined margins, a cup-to-disc ratio of 0.3, flat retinas, and positive foveal reflexes. These findings indicate favorable short-term visual outcomes and reassuring documented posterior segment findings following cataract removal.

The observed improvement is consistent with the visual gains reported by Agarkar et al. [7], who studied 27 eyes from 15 children and adolescents with T1DM and reported an improvement in median visual acuity from 0.8 logMAR preoperatively to 0.15 logMAR at final follow-up. However, the present patient's preoperative acuity was recorded qualitatively as HM in both eyes. Because no validated conversion method was specified, this measurement was not converted to logMAR for direct quantitative comparison. The postoperative UCVA of 6/6 in each eye nevertheless demonstrates a substantial short-term improvement from the documented preoperative state.

Agarkar et al. [7] also reported posterior capsular visual axis opacification in 40.7% of eyes and diabetic retinopathy in 14.8% during follow-up. These findings highlight the need for continued ophthalmic surveillance after cataract surgery in young patients with T1DM. The absence of documented complications during the short follow-up period in the present case does not exclude the possibility of subsequent complications. In addition, conventional IOL implantation does not restore the natural accommodative function of the crystalline lens. The prescription of near-vision spectacles is therefore compatible with the need for near-vision correction despite good uncorrected distance visual acuity.

Postoperative Fundus Assessment and Long-Term Surveillance

Dense bilateral cataracts prevented adequate preoperative visualization of the retina. After surgery, fundus examination documented round optic discs with well-defined margins, a cup-to-disc ratio of 0.3, flat retinas, and positive foveal reflexes. These findings were reassuring at the documented examinations. However, they do not establish that the patient is free from future diabetic retinopathy or other ocular complications. The available records do not establish whether optical coherence tomography or other additional retinal investigations were performed.

The American Diabetes Association Professional Practice Committee for Diabetes recommends an initial comprehensive dilated eye examination in children and adolescents with T1DM after approximately three to five years of diabetes duration, provided the relevant age or pubertal criteria are met [6]. Subsequent screening intervals should be individualized according to retinal findings and risk factors. In this case, the inability to visualize the posterior segment before surgery provided a specific clinical reason to assess the fundus after the media became clear, independent of routine screening timing.

Continued diabetes care and individualized ophthalmic follow-up remain important as the duration of T1DM increases. Longer-term assessment is also needed to monitor visual stability,

refractive status, IOL-related outcomes, and potential retinal complications. The one-month follow-up documented in this case supports a favorable early outcome but is insufficient to determine the long-term prognosis.

Clinical Significance, Novelty, and Limitations

An important clinical feature of this case was the presence of bilateral total cataracts with profound visual impairment in an adolescent with an approximately two-year documented history of T1DM. Although pediatric cataracts associated with T1DM have been reported previously, the exact onset and rate of progression in this patient were unknown. The severity of the cataracts at presentation should therefore not be interpreted as evidence of rapid progression or attributed solely to diabetes.

The main contribution of this report is its description of severe bilateral lens opacity, the limitations of preoperative posterior segment assessment, the use of sequential cataract surgery with posterior chamber IOL implantation, and the favorable short-term visual outcomes. The improvement from HM vision to UCVA of 6/6 in each eye illustrates the potential visual benefit of surgery in this clinical setting. The case also highlights the importance of postoperative fundus examination when dense cataracts initially prevent retinal visualization. These observations are clinically relevant but should not be interpreted as evidence that the presentation is unique or that the findings can be generalized to all adolescents with T1DM.

Several limitations must be acknowledged. First, this is a single case and cannot establish a causal relationship between T1DM and cataract formation. Second, the onset and speed of visual deterioration, detailed cataract morphology before progression to total opacity, and a comprehensive evaluation of alternative etiologies were not available in the documented information. Although no family history of cataract or corticosteroid exposure was reported, other developmental, metabolic, or systemic causes cannot be fully excluded.

Third, HbA1c measurements were available at only two time points and could not establish cumulative glycemic exposure before cataract development. Fourth, the relatively short axial lengths warrant careful clinical interpretation but are insufficient to diagnose microphthalmos. Fifth, postoperative UCVA was documented as 6/6, but postoperative refraction was unavailable in the information reviewed. Finally, follow-up was limited to one month after surgery for each eye, preventing assessment of longer-term visual stability, refractive outcomes, posterior capsule opacification, and subsequent diabetic retinal complications.

Future multicenter studies involving larger pediatric and adolescent populations with T1DM could investigate the relationship between longitudinal glycemic control, cataract onset, cataract morphology, and surgical outcomes. Prospective follow-up would also help characterize long-term visual function, refractive stability, and postoperative complications. Further studies incorporating systematic evaluation of alternative causes of juvenile cataract would help clarify the contribution of diabetes in individual cases.

Overall, this case documents bilateral total cataracts in an adolescent with T1DM and favorable short-term visual outcomes following sequential cataract surgery. The findings support the clinical value of timely cataract management and postoperative ophthalmic assessment, while the etiology and long-term prognosis remain uncertain.

Conclusions

This case describes bilateral total cataracts in a 16-year-old adolescent with an approximately two-year history of T1DM, with visual acuity improving from hand movements in both eyes to 6/6 following sequential cataract surgery. The severe bilateral presentation despite a relatively short documented duration of T1DM is clinically notable, although the onset of cataract and its

causal relationship with diabetes remain uncertain. This case highlights the importance of early ophthalmic evaluation in adolescents with T1DM and supports further research into the relationship between glycemic control and pediatric cataract development, as well as long-term surgical outcomes.

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Ethical Clearance: Ethical clearance was waived by the Institutional Review Board of General Hospital Dr. Zainoel Abidin, Banda Aceh, Indonesia, as this case report involved retrospective reporting of standard clinical care and no experimental intervention.

Informed Consent Statement: Informed consent was obtained from the patient's parent for the reporting of this case.

Data Availability Statement: All clinical data supporting the findings of this case report are included in the manuscript. Additional information may be requested from the corresponding author, subject to patient confidentiality requirements.

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Conflicts of Interest: All the authors declare no conflicts of interest.

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