

Case Report

Acute Bilateral Cataract in Type 1 Diabetes Mellitus

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Abstract

We report a case of a 17-year old boy, who presented acute bilateral cataract and complete vision loss within six days, three months after the diagnosis of Type 1 Diabetes Mellitus (T1DM) under optimal metabolic control (HbA1c 6%). At presentation (HbA1c 10.4%) and after correction of diabetic ketoacidosis (pH 6.917) and the beginning of intensified insulin treatment with insulin glargine once daily and insulin aspart before meals, the patient underwent full ophthalmologic examination, which was completely normal. Only few cases with acute bilateral cataract - all relatively shortly after the diagnosis of T1DM - have been reported. Several hypotheses have been drawn but the exact mechanism of this phenomenon remains unclear. The interesting finding in our case was the clearly elevated insulin autoantibodies (IAA) at the time of cataract formation, negative however at presentation. The relation between the elevation of IAA and cataract formation should be further investigated in diabetic patients.

ABBREVIATIONS

DM: Diabetes Mellitus; IAA: Insulin Autoantibodies; HbA1c: Glycosylated Hemoglobin; GAD-65: Glutamic Acid Decarboxylase Autoantibodies; IA-2: Anti-tyrosine phosphatase autoantibodies; ICA: Islet Cell Autoantibodies

INTRODUCTION

Acute bilateral cataract in patients with newly diagnosed Type 1 Diabetes Mellitus is a rare complication, which may occur within a few weeks or months after starting insulin treatment. The severity may vary, from slight visual impairment to complete blindness within a few days. The association of T1DM and cataract is well documented in literature [1], the risk factors being the duration of diabetic symptoms before diagnosis, diabetic ketoacidosis, poor metabolic control, elevated HbA1c, possibly genetic factors, and treatment with glucocorticoids. However, the pathogenesis of diabetic cataract is poorly understood and there is still no explanation why in some patients with proved optimal metabolic control, cataract is developed, weeks or months after diagnosis.

CASE PRESENTATION

A 17-year old boy presented severe diabetic ketoacidosis (pH

6.917, blood glucose 556 mg/dl, HbA1c 10.4%) after a 3-week history of typical but unrecognized T1DM symptoms (polyuria, polydipsia and weight loss despite recent hyperphagia).

T1DM related autoantibodies were measured as described [2]. Glutamic acid decarboxylase autoantibodies (GAD-65) and islet cell autoantibodies (ICA) were positive: 13.4 (< 1.0) and 1:16 (< 1:4) respectively, while anti-tyrosine phosphatase autoantibodies (IA-2) and insulin autoantibodies (IAA) were negative: 0.5 (< 1.1) and 3.0 (< 8.0) respectively. He was negative for autoimmune thyroiditis and celiac disease. Family history was negative for autoimmune diseases or cataract.

The first eye examination during the initial hospitalization revealed intermittent blurred near vision. His visual acuity was 6/5 (-0.1 logmar) in both eyes with a corrective lens of +1.50 diopters sphere for the right eye and +1.75 diopters sphere for the left. Near vision was recorded as N5 without correction. He reported having some distance glasses in the past which he never actually used but he did not recall the power of the prescription. His convergence was normal at 6cm. On slit lamp examination, anterior segment was quiet with clear cornea and no anterior chamber inflammation. Intraocular pressures were 12 in the right and 13 in the left (measured with Goldman applanation).

On dilated funduscopy there were no considerable findings, no evidence of any diabetic retinopathy changes in either eye and healthy optic discs and maculae. No lenticular opacities were noticed in either eye. At that point the diagnosis was latent hypermetropia and he was advised to start using glasses for near work (+1.50DS in both eyes).

Three months later and while being perfectly controlled, with 95% of his daily blood sugar measurements falling within target (70-150 mg/dl) and an HbA1c of 6.0%, he complained of bilateral visual loss. According to the patient, the deterioration in his vision occurred within six days. His visual acuity was hand movements in both eyes not improving with pinhole. On examination he was found to have bilateral milky white cataracts with no view of the fundus in either eye.

At this point, we decided to recheck his autoimmune status. The only change was the previously negative, now clearly elevated IAA: 1.4 (<1.1).

He underwent uneventful cataract surgery in both eyes with a two week distance in-between. The cataract was completely liquefied and was aspirated only, with no ultrasound use at all. As a result no lens tissue could be sent to immunopathology. Postoperative dilated funduscopy did not reveal any diabetic retinopathy changes in either eye. Both eyes recovered nicely with 6/5 (-0.1 logmar) visual acuity with a small myopic correction which was the actual initial aim. One month after the second eye surgery there was no posterior capsule opacification in either eye.

DISCUSSION

We report a particularly rare case of a pediatric patient that developed acute bilateral cataract 3 months after the diagnosis of T1DM. At presentation ophthalmologic examination was normal and IAA was negative. The interesting finding of the elevated IAA at the time of cataract formation raises a possible *autoimmune hypothesis*, which is further discussed.

Although the association between cataract formation and T1DM is well established in literature [1], development of acute bilateral cataract within weeks or months after diagnosis has rarely been reported. Cornwell et al. [3] reported a case of a 19-year-old newly diagnosed T1DM patient with normal ophthalmologic examination at presentation, developing irreversible bilateral cataract within 6 weeks, despite good metabolic control. Seven out of 14 patients in the group studied by Wilson et al. [4] developed cataract shortly after being diagnosed with T1DM. Skrabic et al. [5] describe a case of acute bilateral cataract 3 months after diagnosis, despite the proved good metabolic control. Acute bilateral cataract between 3 weeks and 24 months after of T1DM diagnosis and initiation of insulin therapy has also been reported by other scientists [3,6,7-15]. Some cataracts can either be transient, improving with good metabolic control or permanent, mostly in cases with poor metabolic control, requiring surgery.

The mechanism of cataract formation in T1DM patients has not been clarified yet. Several possible mechanisms have been proposed to explain this phenomenon. According to the osmotic hypothesis, long-lasting hyperglycemia could lead to an excessive

accumulation of sorbitol in the lens via the polyol pathway, causing osmotic stress and an influx of water from the aqueous humor, resulting in intracellular edema, broken or disrupted fibrils and opacities. However, aldose-reductase mediated inflicted lens alone is not sufficient to explain the occurrence of opacities in patients developing acute cataract. Another mechanism could be the non-enzymatic glycation of lens proteins in association with oxidative stress. In fact, glucose auto-oxidation and non-enzymatic glycation may contribute to the increase of free radical species in the lens, and a loss of antioxidants has been found in lenses under hyperglycemic conditions. Metabolic changes associated with diabetic ketoacidosis could further decrease the availability of antioxidants and promote cataractogenesis. In mechanisms, intracellular electrolyte and biochemical changes occur, leading to breakage of protein and cellular death and ultimately to acute irreversible cataract. But the question why in all the patients with T1DM and acute bilateral irreversible cataract with the latter always developing several months after diagnosis and initiation of insulin therapy, in a period with proven good metabolic control, still remains unanswered.

In long-standing type 1 diabetic adults, the prevalence of cataract is about 20 times higher than the one observed in newly diagnosed children. This may indeed be due to an enhanced production rate of lens fibers that could have been stimulated by insulin. It has been documented that insulin induces mitogenesis of the epithelial cells of the lens with an increased growth of the individual lens fibers. The only difference between hyper-acute cataract in newly diagnosed T1DM children and young adults and cataract diagnosed in long-standing T1DM adults lies in the long period of the disease and the insulin treatment which could be responsible for the highest prevalence of cataract in the latter group [1,7,13,16].

Some other researchers have suggested that rapid glycemic improvement leads to a hypoxic phenomenon which may also affect the activities of the protective enzymes in the lens, resulting in increased oxidative stress and subsequently to acute cataract formation [16]. But rapid glycemic improvement is what happens in every child or adult presenting with T1DM. Should we not expect a higher incidence of cataract formation if this were the explanation?

All these theories have no clear explanation why some patients, such as our patient, develop acute cataract and mainly why this happens several weeks or a few months after diagnosis. The polyol pathway and the contribution of ketoacidosis do not seem to be the most likely explanations here, as the cataract developed during a stable well controlled period with 95% of the daily blood sugar measurements being within target (70-150 mg/dl) rather than during hyperglycemia. The mechanism of the increased growth of the individual lens fibers caused by insulin cannot be ruled out. However, even this theory fails to explain the acuteness of the phenomenon.

To the best of our knowledge, there are no reports of the values of IAA in the published cases at the time of the acute bilateral cataract. However, it is documented that shortly after the beginning of the insulin therapy in diabetic patients elevated IAA are found in many cases, as in our case [17-21]. This period seems to coincide with the occurrence of acute bilateral cataract

and could imply an autoimmune mechanism for the cataract that occurs after the diagnosis in patients with good metabolic control and a possible genetic predisposition for cataract formation. Moreover, while lens epithelium is not dependent on insulin for glucose uptake [6], still the insulin receptors present in normal lens, as well as in lens of diabetics, and disappear only when cataract has developed [22]. Knowing that IAA can interfere with the pharmacological action of administered insulin, resulting in insulin autoimmune syndrome [23], one could construct a quite challenging and intriguing *autoimmune hypothesis* that certainly needs further investigation.

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