Case Report

# VISUAL SYMPTOMS DURING HYPOGLYCEMIA: A CASE SERIES

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## ABSTRACT

***Objective:*** To recognize visual symptoms that occur during hypoglycemia to help patients avoid severe hypoglycemic events.

***Methods:*** A series of adults with insulin-requiring diabetes were asked to complete questionnaires concerning visual symptoms during hypoglycemia (blood glucose <70 mg/dL). For patients using a continuous glucose monitoring system (CGMS), glucose levels during the time of symptoms were confirmed from downloads of their devices and meter readings when available. Pregnant women and those with an inability to complete the survey were excluded. Demographic information and type, duration, and complications of diabetes were obtained from medical record review.

***Results:*** Participants (n = 107) were 68.6% female, with a mean age of 50.4 years, duration of diabetes of 9 to 46 years, 59.2% of participants had type 1 diabetes (39% pump users) and 22 participants were using CGMS (2 of these 22 participants were excluded because of incomplete data). Of the CGMS users, 75.0% had ≥1 visual symptom, and 86.6% had glucose levels <60 mg/dL with visual symptoms. Blurred vision was the most common visual symptom reported during hypoglycemia (73.3% of all participants and 65.0% using CGMS), followed by dimness of vision (44.7%), "black spots" (37.1%), central black hole (34.3%), double vision (15.3%), and transient complete loss of vision (2.8%). Time from onset to resolution of symptoms was less than 30 minutes in 80.0% of participants.

***Conclusion:*** Visual symptoms are common during hypoglycemia but not widely appreciated. Blurred vision, common with hyperglycemia, is also seen during hypoglycemia. It is especially important for patients with poor hypoglycemic awareness to be educated to better recognize that changes in vision may indicate hypoglycemia. **(AACE Clinical Case Rep. 2015;1:e32-e35)**

**Abbreviation:**
**CGMS** = continuous glucose monitoring system

## INTRODUCTION

Studies in both type 1 and type 2 diabetes have shown that intensive glycemic control reduces long-term complications (1-3). Unfortunately, severe hypoglycemia remains a major problem in adults with insulin-requiring diabetes (4). The risk of severe hypoglycemia increases with use of intensive insulin regimens as well as in type 1 diabetes of long (>20 years) duration (5).

Many individuals with long-standing diabetes have poor hypoglycemic awareness (4,6,7). The classic adrenergic symptoms may be lacking. Some patients experience visual disturbances (8) but are unaware that these can be signs of hypoglycemia. Symptoms such as blurred vision and diplopia have been associated with hypoglycemia (9) but are not commonly included in diabetes education materials. Reduction in contrast sensitivity and color vision have also been described (8,10,11).

In earlier work using glucose-insulin clamp experiments, we demonstrated that acute hypoglycemia can affect central vision in individuals with normal glucose tolerance and diabetes mellitus (12). The current study was conducted to better understand the visual symptoms that

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commonly occur during hypoglycemic episodes in patients with insulin-requiring diabetes mellitus in real-world ambulatory settings. The goal was to use this information to better educate patients to assist them in recognizing symptoms of hypoglycemia.

## METHODS

This is a case series of ambulatory adults with type 1 and 2 diabetes followed at the Joslin Diabetes Center at SUNY Upstate Medical University in Syracuse, New York. All participants were treated with insulin. None were taking other glycemic control medications. Pregnant women, those with an inability to complete a written survey, including patients with dementia, mental retardation, or the presence of severe eye disease with significant visual impairment were excluded. Demographic information (age, gender) and data regarding type and duration of diabetes, type of insulin therapy, and presence of eye disease were obtained from patients' medical records. Participants were requested to complete a written survey immediately after episodes of hypoglycemia and to record the time and date of each event. Blood glucose monitoring device downloads were examined, and for those using a continuous glucose monitoring system (CGMS), downloads of the CGMS were performed. The survey used to record visual symptoms was adapted from Hepburn et al (13) and our earlier work (12). Participants were asked if they experienced blurred vision, dimness of vision, double vision, a black hole in the middle of their vision, black spots, floaters, loss of vision, or other visual symptoms, as well as questions concerning the presence of adrenergic and neuroglycopenic symptoms. Participants were also asked if visual symptoms resolved with correction of low blood sugar, how long it took for symptoms to resolve, and at what blood glucose level symptoms occurred. All participants signed informed consent. This study was approved by the Institutional Review Board for the Protection of Human Subjects at SUNY Upstate Medical University.

## RESULTS

Of the 107 participants, 22 were using a CGMS; 2 of the 22 were excluded because of incomplete data. Participant characteristics are shown in Table 1. All of the patients using a CGMS had type 1 diabetes. Vision survey results are shown in Figure 1. Blurred vision was the most common visual symptom reported (73.3% of all participants), followed by dimness of vision (44.7%), multiple black spots in front of the eyes (37.1%), a black hole in the middle of the vision (34.3%), double vision (15.3%), and transient complete loss of vision bilaterally (2.8%). The survey data from participants who used CGMS (permitting verification of the hypoglycemia) compared to those who did not use a sensor were similar (Fig. 1). Seventy-five percent of the participants who used CGMS (n = 15) had visual symptoms with hypoglycemia (13 had >1 visual symptom, 2 had only blurred vision); 5 of the 20 participants did not report visual changes. Eighty-seven percent of participants with a visual symptom had a glucose level below 60 mg/dL at the time of hypoglycemia, as confirmed by CGMS or meter download or meter reading. Only 13.3% of participants had a blood glucose level between 61 and 90 mg/dL at the time of visual symptoms. Time from onset to resolution of symptoms was less than 15 minutes in 46.6% of participants, 15 to 30 minutes in 33.3% of participants, and 30 to 60 minutes in 20.0% of participants. In no patient did the visual symptoms last more than 1 hour. All of the participants using CGMS described having adrenergic/neuroglycopenic symptoms with at least some of their hypoglycemic episodes. For the 20 participants using CGMS, the most common nonvisual symptoms were sweating (n = 17), confusion (n = 16), weakness (n = 16), inability to concentrate (n = 15), warmness (n = 14), drowsiness (n = 14), shivering (n = 12), tremor (n = 12), tiredness (n = 12), pounding heart (n = 11), dizziness (n = 10), difficulty speaking (n = 9), perioral tingling (n = 8), feeling tearful (n = 7), and hunger (n = 6).

## DISCUSSION

The risk of hypoglycemia increases with use of intensive insulin regimens. This is a particular problem in poorly controlled adults with type 1 diabetes of >20-years duration. A recent study from the Type 1 Diabetes Exchange registry showed that the incidence of severe hypoglycemia is lowest when the hemoglobin $A_{1c}$ level is between 7.0 and 7.5%, but overall, severe hypoglycemia over the previous year in that study was reported in 18.6% of participants with type 1 diabetes of >40-years duration (5). Many individuals with long-standing diabetes no longer have adrenergic symptoms with hypoglycemia and have poor hypoglycemic awareness. Visual disturbances that occur in individuals with diabetes during hypoglycemia may be underrecognized.

In earlier work (12), we examined vision changes during acute hypoglycemia in individuals with and without diabetes by testing contrast sensitivity and spatial retinal responses (using multifocal electroretinograms). Hypoglycemia (blood glucose 50 to 55 mg/dL), which was induced with the hyperinsulinemic hypoglycemic and euglycemic clamp procedure, was associated with a reduction in contrast sensitivity. The study also demonstrated that acute effects of hypoglycemia in the human eye predominantly involve central vision, originating, at least in part, in the retina. These changes were observed in people with normal glucose tolerance and diabetes, none of whom had retinal disease.

In the current case series, patients commonly reported visual symptoms during hypoglycemia in an ambulatory

**Table 1**
**Patient Characteristics**

| Characteristic | All Participants n (%) | Participants With Sensor n (%) |
|---|---|---|
| Male | 33 (68.6) | 4 (20.0) |
| Female | 72 (31.4) | 16 (80.0) |
| Age (years, mean) | 50.4 | 49.6 |
| Duration of Diabetes (years, range) | 9-46 | 12-46 |
| Type of Diabetes | | |
| Type 1 | 62 (59.2) | 20 (100) |
| Type 2 | 43 (40.9%) | 0 |
| Insulin Therapy (100%) | | |
| Insulin Pump | 41 (39.0) | 15 (75.0) |
| Injections | 64 (61.0) | 5 (25.0) |
| Retinopathy Status | | |
| None | 56 (53.3) | 12 (60.0) |
| Nonproliferative | 18 (17.1) | 3 (15.0) |
| Proliferative or macular edema | 14 (13.4) | 3 (15.0) |
| Unknown | 17 (16.2) | 2 (10.0) |

setting. Blurred vision, the most common visual change, is also common during hyperglycemia. This suggests that patients need to be taught to test their glucose levels at the onset of blurred vision.

It is of interest that some of the participants commented that they had been unaware of the association of these vision changes with hypoglycemia until completion of the survey. They had experienced visual symptoms during hypoglycemia but had not previously thought that these symptoms were a consequence of hypoglycemia, and commented that this information will help them recognize hypoglycemic episodes in a timelier manner.

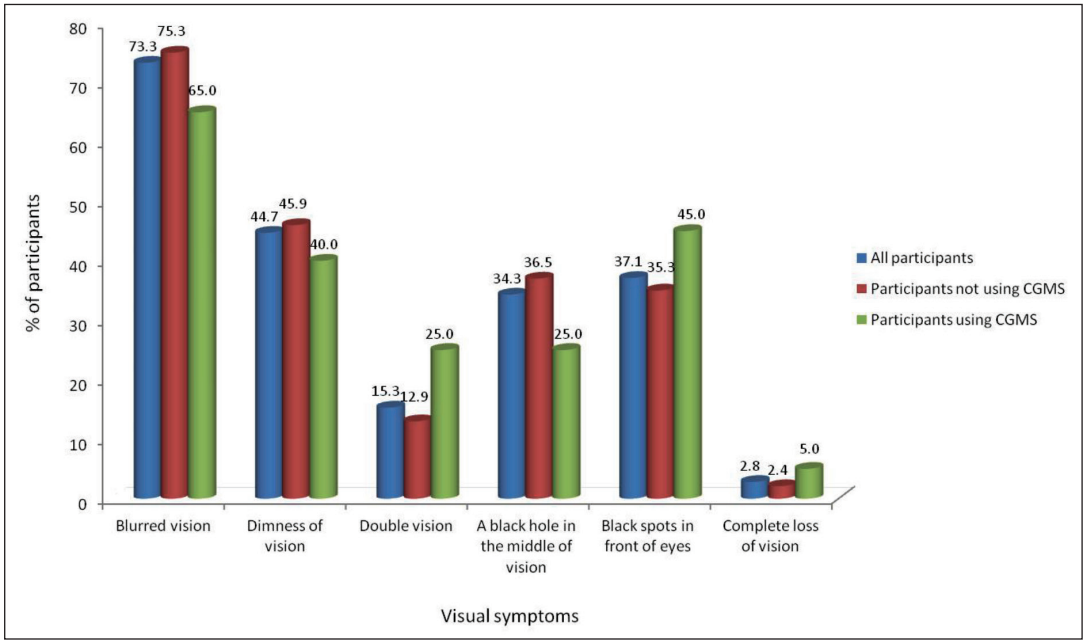


**Fig. 1.** Visual symptoms reported by participants during hypoglycemia. *CGMS* = continuous glucose monitoring system.

A limitation of this case series is that not all patients performed a fingerstick glucose test or were wearing a CGMS at the time of hypoglycemia; therefore, not all events were confirmed. However, the percentage of individuals reporting specific symptoms was similar in those with confirmed and unconfirmed hypoglycemia. Our small sample size may not be representative of the population of insulin-requiring diabetes patients. We did not have reports of eye examinations for many of the participants, and observer (self) bias is possible, as the patient surveys contained a list of possible eye symptoms.

## CONCLUSION

In conclusion, these results suggest that visual symptoms during hypoglycemia are common and should be included in diabetes education materials. This may be particularly important for individuals with diabetes of long duration and those with poor hypoglycemic awareness, where earlier recognition and treatment of hypoglycemia may help prevent a severe episode. The findings also have implications for driving and other common activities in daily life, where avoidance and prompt recognition and treatment of hypoglycemia are critical. As a subtle visual symptom may be an initial symptom of hypoglycemia, increased awareness of this possibility is important for providers and patients.

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## DISCLOSURE

The authors have no multiplicity of interest to disclose.

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