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Case Series on Implementation of Continuous Glucose Monitoring for Better Glycemic Control without Long-acting Insulin

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Abstract

In our case series, we are describing 6 patients with uncontrolled, complicated type 2 Diabetes Mellitus (Type 2-DM). Although they were self-monitoring their blood glucose (SMBG) at least 4 times a day, they continued to have suboptimal glucose control. Continuous glucose monitoring (CGM) was started at our Internal medicine residency primary care clinic. The patients were educated on diet, lifestyle changes, and how to adjust their insulin regimen according to their blood glucose results from the CGM as the standard of care. They were called every two weeks by the representative of our CGM team to monitor and answer any queries regarding insulin adjustment, blood glucose monitoring, diet, physical activity, or lifestyle. The CGM team included Internal medicine and transitional year medical residents and a board-certified endocrinologist who was a member of our clinic. Moreover, the patients were seen at the clinic once every month by a member of the CGM team. Long and rapid-acting Insulins were started to achieve optimal glucose control initially. Eventually, Insulin dosage was gradually reduced, and the patients we described were started on alternate agents like oral antidiabetic agents with or without injectable glucagon-like peptide GLP-1 receptor agonists. The five-hour postprandial C-peptide was checked after discontinuation of insulin in all of our patients and was normal. Within a few months of CGM initiation, there was a significant improvement in the patients' glucose control which was maintained after stopping the Insulin. Some patients were also able to lose weight. We concluded that CGM could be initiated safely in an internal medicine residency clinic not only at specialized endocrine clinics in a project that was managed primarily by internal medicine and transitional year residents under the supervision of a member of the clinic who was board certified in endocrinologists. We also demonstrated the introduction of CGM instead of SMBG in patients with Type 2-DM helped them to achieve better glycemic control with insulin, overcome glucose toxicity, and eventually stop the insulin and maintain excellent glucose control only with oral antidiabetic agents with or without injectable GLP 1 receptor agonist.

Keywords: Diabetes Mellitus Type-2, Continuous glucose monitoring (CGM), HbA1c, Self- Monitoring Blood Glucose (SMBG), internal medicine residents, board certified endocrinologist

Introduction

Diabetes Mellitus is a metabolic disorder that affects more than 34 million people of all ages in the USA, which is around 9-10% of the US population. DM has several categories including Type 1-DM, Type 2-DM, maturity-onset diabetes of the young, gestational diabetes, secondary causes due to endocrinopathies, etc. [1]. The main subtypes of DM are Type 1-DM and Type 2- DM, which classically result from defective insulin secretion (type 1) and defective insulin secretion and action (type 2). Type 1-DM usually starts in children or adolescents, although 20% are encountered in people above the age of 20. Type 2-DM is thought to affect middle-aged and older adults, with an increased incidence of obesity, but we now observe it in children and adolescents as well. Type 2-DM is the most prevalent one affecting 90% of all diabetic patients while Type 1-DM affects the remaining 10% of the patients with DM [1].

Managing diabetes mellitus can be challenging for patients and the diagnosis of diabetes itself could be stress-inducing as well. Patients need to acquire knowledge regarding their new diagnosis. They need to change their diet and lifestyle as well as incorporate physical activities in their day-to-day life. They also need to know about their newly prescribed medications, learn to self-monitor blood glucose (SMBG) if they are on

Insulin, and also learn about complications of diabetes. All these combined could be overwhelming for the patients.

Moreover, SMBG could may frustrate patients as they should check fingerstick blood glucose at least 4 times a day. Also, self-monitoring of blood glucose does not provide an accurate picture of the glucose trends throughout the 24 hours. It measures the glucose at one point in time in this 24-hour period, which is usually not enough to obtain a good picture of glycemic control [2,3].

In recent years, with the advancement of medical technology, there is a more accurate way to monitor 24-hour blood glucose which is termed continuous glucose monitoring (CGM). The introduction of the CGM is likely the most important advancement in Diabetology in the last 20- years. This means using a device to estimate someone's blood glucose level throughout the 24 hours. This can be done by using a compatible with the CGM iPhone or receiver to monitor the glucose values 24 hours a day. Studies have shown seeing blood glucose in real-time can help patients make informed decisions about food consumption, physical activities, and medication adjustments, which helps patients achieve better glycemic control [3, 4,5,6]. The CGM devices have become user-friendly as they become smaller, precise, convenient to use, and covered by most insurance carriers. Randomized and observational studies of real-time CGM systems have demonstrated improved glucose control measured by time in range (TIR), decreased glucose variability measured by coefficient of variation (CV), decreased episodes of hyperglycemia and hypoglycemia compared to SMBG in patients who are on multiple injections of insulin per day with type1-DM and Insulin-requiring Type 2-DM [7,8,9,10,11,12]. The initial clinical trials with the use of CGM compared to SMBG were done in patients with Type 1-DM [7,8,9]. However, current studies suggest similar excellent results with the use of CGM compared to SMBG in patients with Type 2-DM [10,11,12]. CGM devices measure interstitial blood glucose every 1 to 5 minutes, and the results can be transmitted to a compatible smartphone device or portable receiver. Also, if the patient has smartphone compatibility with their CGM devices,

they can share their glucose information with their medical providers. From the average glucose measurements through the CGM devices, we can estimate the glucose management indicator (GMI), which usually correlates with HbA1c level without being subjected to the inaccuracy of HbA1c levels in patients with anemia, chronic kidney disease, polycythemia, cirrhosis of the liver, etc.

The use of CGM devices has been shown to improve the quality of life and psychological well- being of patients with DM. Cost-effectiveness has been reported with the use of CGM devices compared to SMBG. Current recommendations by the American Diabetes Association (ADA) about control of blood sugar using CGM are described in Figure 1 [13]. The recommendations by the ADA agreed with other international diabetic recommendations [14].

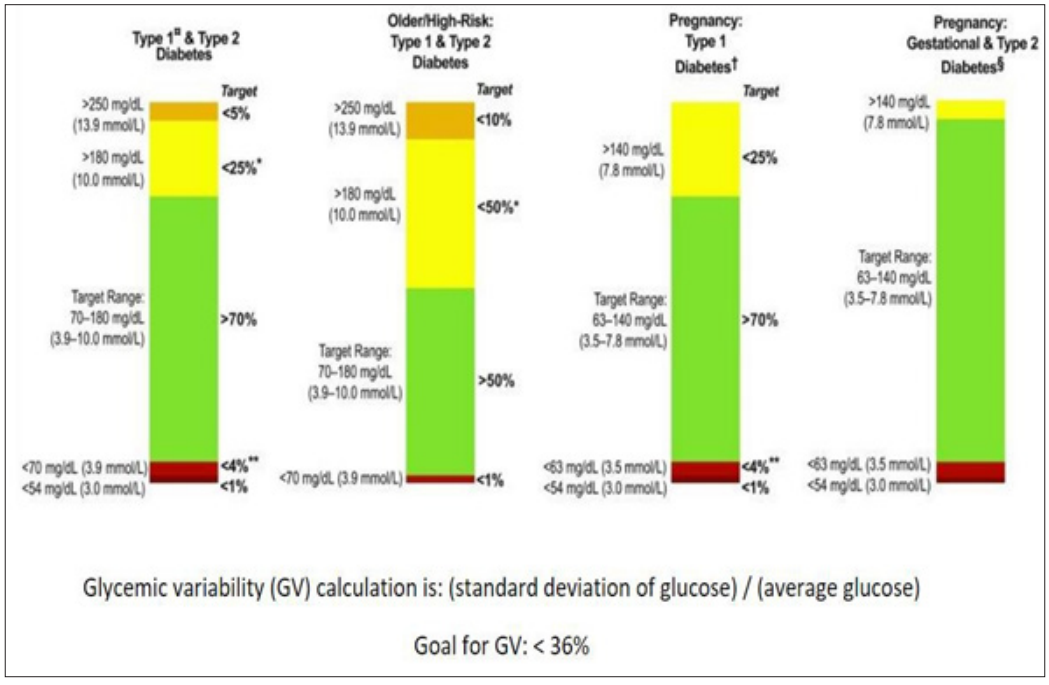

Figure 1: ADA recomendations for blood glucouse target levels using CGM

As CGM devices have become more popular and accurate over the years, a new way to estimate good glycemic control has emerged, which is called time in range (TIR). TIR is the amount of time the patients spend in the target blood glucose range which is 70-180 mg/dl. Goal TIR is around 70% which is about 17 hours of a 24-hour day, unless the patients are older or pregnant as described in Figure 1. Studies have shown that patients with >70% TIR, achieved better clinical outcomes. Different studies showed that TIR >70% assessed by using CGM has negative associations with the development of microvascular complications in patients with diabetes like diabetic retinopathy and diabetic nephropathy [15]. Other studies compared the association between TIR and carotid intima-media thickness (CIMT) which is a surrogate marker of cardiovascular disease. It was revealed that patients with normal CIMT had a higher TIR compared with those with abnormal CIMT and a 10% increase in TIR was associated with a 6.4% reduced risk of abnormal CIMT. These data showed that TIR correlates inversely with the incidence of micro and macrovascular diabetic complications.

Case Report #1

A 51-year-old man came to the internal medicine (IM) residency clinic in 2023 to establish care. He complained of low back pain secondary to left-sided pyriformis syndrome and had recently received IV Dexamethasone. He had Type 2-DM for 7 years. He was previously taking combination therapy with Empagliflozin and Glucophage. However, he lost his insurance coverage, was off the combination therapy for 1 year, and was only taking Glucophage ER 500 mg daily. He was self-monitoring his glucose (SMBG) 4-times a day at home, and it was ranging around between 225-350 mg/dL. Previously, it was around 130 mg/dl when he was on combination treatment with Empagliflozin and Glucophage 7 years earlier.

During our first encounter with him at the clinic, his BMI was 43.94 kg/m2, HbA1c was 12.7% and point of care glucose was 310 mg/dL. Urinalysis showed high glucose. He was started on 32 Units (U) Insulin Glargine at bedtime, 10 U Insulin Lispro, three times daily before meals, Empagliflozin 10 mg once daily, and subcutaneous Dulaglutide 0.75 mg once weekly was started. Glucophage ER dose was increased from 500 mg to 1000 mg once daily. He was instructed to monitor his blood glucose at home and follow up in four weeks. He was also educated and given CGM-Freestyle Libre 3 and he was educated on how to adjust his Insulin based on his CGM reading. Also, a pamphlet with different food calories and carbohydrate content was given to the patient with advice on caloric and carbohydrate intake given by the representative of our CGM team. The patient was sharing his CGM data with our clinic. Our CGM team included internal medicine and transitional year medical residents who were functioning under the supervision of a board-certified endocrinologist who was a member of our clinic as well. During his 4-week follow-up at the residency clinic, he reported compliance with the antidiabetic regimen. Point of care glucose was 115 mg/dL. He also lost 10 pounds since his last visit. Empagliflozin was increased from 10 mg to 25 mg daily. He was advised to gradually decrease the Insulin doses because his blood glucose was optimally controlled. The GMI in the last 2-weeks was 7.3%, blood glucose was within the target range 73% of the time and was ranging from 181-250 mg/dL 27% of the time, and was less than 5% above 250 mg/dl. He had no hypoglycemia and his average blood sugar was 164 mg/dl in the last 14-days. A representative of our CGM team called him every two weeks and adjusted his treatment under the supervision of our board-certified endocrinologist. He was also seen every month in the clinic. His Insulin was stopped a month before his last visit to our clinic. A five-hour postprandial C-peptide was checked while off Insulin and it was normal. On his last visit to our residency clinic, while taking Glucophage ER 1000 mg and Empagliflozin 25 mg once daily as well as subcutaneous Dulaglutide 1.5 mg once weekly his GMI was 6.8%. His average blood glucose was 146 mg/dL. Blood glucose was within the target range 96% of the time and 4% was above target between 180-250 mg/dl. He had lost about 20 pounds over the last 3-months.

Comment

This is an example of the successful introduction of the CGM device Freestyle Libre 3 at the Internal Medicine residency clinic with the monitoring done by the representative of our CGM team which included internal medicine and transitional year residents under the supervision of an endocrinologist who was a member of the clinic. With the help of the CGM, the patient was able to overcome the glucose toxicity, stop his Insulin, and control his blood glucose on oral antidiabetic medications and injectable GLP-1 receptor agonists.

Case Report #2

A 62-year-old gentleman came to our internal medicine residency primary care clinic in 2022 to establish care. He had a complicated history of Ulcerative Colitis leading to a perforated cecum which required an ileostomy. He also had Type 2 Diabetes with Diabetic Neuropathy and was taking Glucophage 1000 mg once daily until his previous provider stopped accepting his insurance and he was unable to acquire refills of his prescription. Only a few days before we evaluated him at the clinic, he was seen at an emergency department with decompensated DM type-2. He was found to have a random blood glucose of more than 300 mg/dL. He was discharged home with refills of Glucophage ER 1000 mg after a workup for diabetic ketoacidosis which was negative. During his first clinic visit with us, he reported compliance to his home antidiabetic agent and was SMBG 4-times a day. His HbA1c was 13.4%. He was started by our CGM team, described in case 1, on Insulin Glargine 18 U at bedtime and Insulin Lispro 6 U three times daily before meals. Subcutaneous Semaglutide 0.25 mg once a week was started as well, and home Glucophage ER 1000 mg daily was continued. He was also given a CGM device, Dexcom G6, and later changed to Dexcom G7. He was given educational materials on Type 2- Diabetes and instructions on lifestyle changes for better glycemic control and adjustment of his Insulin regimen based on his CGM data. Members of our CGM team internal medicine and transitional year resident as well as our endocrinologist started monitoring his blood glucose based on the CGM data that he was sharing with the

clinic and contacted him once every two weeks for adjustment of his treatment. He returned to our clinic for a 4-week follow-up. His CGM data showed good glycemic control. GMI was 6.5 % with blood glucose in the target range 90% of the time. As a result, the Insulin was stopped. Semaglutide dosage was increased from 0.25 mg to 0.5 mg once a week to maintain glycemic control without Insulin and to facilitate weight loss and he continued also taking Glucophage ER. A five-hour postprandial C-peptide was checked while off Insulin and it was normal.

During his 3-month visit, GMI was 6.5% without the use of Insulin. TIR was 90% with no hypoglycemic events. He was advised to follow up with our clinic every 2 months. Also, the representative of our CGM team called him every two weeks to answer any questions or provide advice on lifestyle modification. He was most recently seen in 2023 when he was found to have a GMI of 5.5% by using only peroral antidiabetic medications and injectable GLP-1 receptor agonists.

Comment

This is another example of the initiation of a CGM device at our internal medicine residency clinic and we continued to observe improved glycemic control in patients after the initiation of CGM in a process governed by our CGM team with the active participation of our internal medicine and transitional year medical residents and endocrinologist. Our patient in this case report was able to achieve adequate glycemic control after overcoming glucose toxicity with the initial help of Insulin. As a result, we were able to discontinue the Insulin and continue having excellent glycemic control with the help of oral antidiabetic agents and injectable GLP-1 receptor agonists. This case report is also, an excellent example of how CGM devices help improve glycemic control, overcome glucose toxicity, and achieve excellent results without the use of Insulin.

Case Report #3

A 62-year-old male patient was seen in our internal medicine residency Clinic in the summer of 2023 because of decompensated Type 2-DM. His HbA1c was 10.9%. The patient was using different antidiabetic per oral medications and injectable GLP-1 receptor agonist Semaglutide once a week inconsistently and was not strictly monitoring his diet. He was also SMBG four times a day with blood glucose levels ranging from 230-300 mg/dl. His BMI was 44 kg/m^2.

During this visit, the CGM team decided to place the patient on CGM Dexcom G7 to allow monitoring of his blood glucose levels throughout the 24 hours. He was started on dulaglutide 24 units nightly along with rapid-acting Insulin Lispro 5 units before his largest meal. He was also started on Dulaglutide 0.75 mg daily and Empagliflozin 10 mg daily. Other antidiabetic medications were discontinued. He had morbid obesity and was offered bariatric surgery which he refused. He was given instructions about lifestyle modification and started on GLP-1 receptor agonist and SGLT2 antagonist for the treatment of his Type 2-DM and given Topiramate also to help with the treatment of his morbid Obesity. Upon starting the CGM, the patient became very compliant with his treatment, diet, and lifestyle interventions prescribed and followed by the CGM team. Upon review of his Dexcom readings 2 months later, it was found that his blood sugar levels were in the target range 75% of the time with a GMI of 7.3% and average blood glucose of 162 mg/dl. Blood sugars continued to improve and insulin had to be titrated down to prevent hypoglycemic episodes. Eventually, his Insulin was stopped. The Dulaglutide was increased to 1.5 mg subcutaneously weekly and the Empagliflozin dose was increased to 25 mg per day. A five-hour postprandial C-peptide was checked while off Insulin and it was normal.

The patient continued to do well. Recent Dexcom G7 readings showed blood glucose in the target range 72% of the time, average blood glucose was 161 mg/d, and GMI was 7.2% in 2023 without the use of Insulin. The CGM team continued to follow his CGM data and adjust his treatment every two weeks and he continued to be seen in our clinic monthly.

Comment

This is an excellent example of how the CGM device helped our patient to improve his compliance with his treatment, overcome glucose toxicity, discontinue his Insulin, and achieve excellent diabetic control on oral antidiabetic agents and injectable GLP-1 receptor agonists.

Case Report #4

The patient was a 75-year-old male with a past medical history of hypertension, sleep apnea, BPH, and Type 2-DM presented to our clinic for care about his decompensated DM in 2022. He had already been diagnosed with Type 2-DM before and was treated with different medications including Insulin, but stopped taking his Insulin because of hypoglycemic episodes. He was inconsistently SMBG 4 times a day. He was taking at the time when he visited our clinic only Glucophage ER 1g a day and his HbA1c was 12%. He was restarted back on a low-dose basal-bolus Insulin regimen because of a history of hypoglycemia and Glucophage was increased to 1g twice a day. At that time, the patient stated that he was interested in CGM Dexcom G7 which was started in our clinic by a member of our CGM team. He was given strict instructions about the adjustment of his Insulin based on his CGM data and closely followed every 2-weeks by phone and every month in the clinic by a member of our CGM team and his medications were adjusted at those visits. The patient was also given a pamphlet with carbohydrate and caloric content of different foods and advised how much to eat and was given advice about his lifestyle changes which he followed strictly. Based on his CGM readings, his blood sugar was between 80-100 mg/dl the majority of the time during the first 3-months of treatment. He experienced episodes of mild hypoglycemia around 6% of the time which allowed us to decrease and eventually to stop his Insulin and start the GLP-1 receptor agonist Semaglutide subcutaneously 0.25 mg once a week and SGLT2 receptor antagonist Empagliflozin 10 mg a day together with Glucophage 1 g twice daily. A five-hour postprandial C-peptide was checked while off Insulin and it

was normal. In the follow-up visit one month after stopping his Insulin, the GMI was 6.1% with average blood glucose of 126 mg/dl and time in range (TIR) of blood glucose 91% without the use of Insulin. His diabetic regimen was de-escalated, and Glucophage was stopped. During the next year until the present, the patient has been doing extremely well as reflected by his CGM data. His blood glucose levels were within the target range greater than 95% of the time. There were less than 1% hypoglycemic episodes and high glucose levels between 180-250 mg/dl were around 5%. Semaglutide has been up-titrated to the maximum tolerated dose of 2 mg per week and the patient has been losing weight. His latest GMI was 5.9% with an average blood glucose of 119 mg/dl and is currently only taking Empagliflozin and Semaglutide. The CGM team was closely following the patient during all this time and adjusting his medications.

Comment

Our patient appears very sensitive to Insulin. Because the CGM can constantly monitor the blood sugar levels throughout the day and night (versus manually checking the blood glucose with the glucometer 4 times a day), the patients using CGM are aware of hypoglycemic episodes during times they did not check their blood sugar levels. Some patients with long standing diabetes have decreased to no awareness of hypoglycemic symptoms. This can potentially increase the risk of seizures, falls, and overall mortality. Newer glucose monitors have an alarm feature that provides alert if the blood glucose level is below a certain value. This prompts the patient to act, such as eating a snack or decreasing/holding Insulin for the next dose. For our patient, repetitive hypoglycemic values helped us to modify his Insulin regimen by either decreasing the required dosage or eventually stopping it altogether. As such, the patient is now off of all forms of Insulin and he has excellent blood glucose control using only oral hypoglycemic agents and injectable GLP-1 receptor agonists.

Case Report #5

The patient was a 68-year-old male with a past medical history of Diabetes Mellitus Type- 2, hypertension, and hyperlipidemia who came to our internal medicine residency clinic in 2021 for treatment of his diabetes. He was recently been hospitalized for Diabetic Ketoacidosis (DKA) and acute kidney Injury (AKI). Before the hospitalization for DKA the Type 2-DM was treated with Glucophage 1g twice a day. Upon discharge from the hospital for DKA he was treated with basal bolus Insulin regimen. He was self-monitoring his blood glucose at home. His HbA1c was 9.6%. During his visit to our clinic, the CGM team started the patient on CGM Dexcom G6, later changed to Dexcom G7, and basal-bolus Insulin and he was counseled on a diabetic diet, exercise, and management of his Type 2 DM based on his CGM data by a representative of our CGM team. At a one-month follow-up visit, there was improved diabetes control, with morning glucose in the 110s. The GMI was 7.3% with an average blood glucose of 160 mg/dl. The Insulin dosages were decreased. At a two-month follow-up visit, the patient's Insulin was discontinued and he was treated with Semaglutide 0.25 mg subcutaneously once a week and Empagliflozin 10 mg a day together with Glucophage 1 g twice a day. A five-hour postprandial C-peptide was checked while off Insulin and it was normal. In another month his GMI improved to 7.0%. He expressed the desire not to have injectable medications and this is why his subcutaneous weekly Semaglutide was changed to an oral one once a day. The CGM team closely followed the patient, eventually discontinued Glucophage, and treated the patient only with per oral Semaglutide and Empagliflozin with the last GMI of 6.6% and average blood glucose of 138 mg/dl and TIR above 70% in 2023. He also was very compliant with his lifestyle modification plan and lost 30 pounds in the last 2 years

Comment

This case exemplifies the benefits of management of Type 2 Diabetes with the integration of CGM Dexcom G6 and G7. The CGM system facilitated close monitoring allowing the patient, the medicine residents, and the endocrinologist from our CGM team to track trends and patterns of the patient's BG reading and to make timely individualized medication adjustments based on the patient's requirements. Furthermore, because the CGM is constantly monitoring blood sugar levels throughout the 24 hours, the patient became aware of his hyperglycemic and hypoglycemic episodes and eating patterns. Throughout the process, the patient became more compliant with his dietary regimen, and medication treatment which resulted in excellent blood glucose control without the need for Insulin and significant weight loss.

Case Report #6

In this case report, we present a 54-year-old female patient with a complex medical history that includes Diabetes Mellitus type 2, complicated by peripheral neuropathy, Hypertension, and a history of Pulmonary Embolism treated with anticoagulation who sought care at our clinic in 2021, with primary goal of establishing comprehensive diabetes management. She came to our clinic after the hospitalization for sepsis secondary to right toe necrotizing fasciitis necessitating amputation. Remarkably, the patient did not see a medical provider in the last couple of years and was unaware of her medical problems. During her hospital admission, her HbA1c level was alarmingly high at 13.5%. She was discharged from the hospital on a basal-bolus Insulin regimen and was SMBG 4 times a day. Upon initial presentation in our clinic, her HbA1c was 8.2%, and her BMI was 31.95kg/m2. We initiated a tailored treatment plan that included Insulin Glargine 25 units every night, rapid-acting Insulin Lispro 15 units before each meal, Semaglutide 0.25mg subcutaneously once a week initially, which was later discontinued due to side effects and Glucophage ER 500mg once daily, and then we started CGM Dexcom G6. Our primary objective was to achieve an HbA1c level below 7%. Over three months of continuous monitoring of her glucose levels via CGM Dexcom G6 by our CGM team there was substantial improvement. GMI, which reflects the HbA1c, decreased from 8.2% to 6.4%. Notably, she ceased using Rapid Acting Insulin due to improved glucose control with daytime glucose readings around 110-120 mg/dL. We adjusted her medication regimen, reducing Insulin Glargine to 20 units at bedtime and increasing

Glucophage to 1g twice a day. However, subsequent Dexcom data indicated elevated glucose levels, with an average blood glucose of about 171 mg/dL and bedtime levels exceeding 200 mg/dL. The CGM team collaborated with the patient to optimize her dietary regimen. We also started Empagliflozin 10mg and later 25 mg a day. During follow-up visits over the next six months, her GMI improved to 6.1%. Home glucose readings consistently ranged from 100-140 mg/dL with the average blood glucose of 126 mg/dl. The CGM team and the patient made the conjoined decision to discontinue Insulin Glargine due to improving glucose control and the challenges associated with its use. A five-hour postprandial C-peptide was checked while off Insulin and it was normal.

In subsequent follow-up appointments, her GMI continued to be stable at 6.7% without any Insulin and only with treatment with Glucophage and Empagliflozin. Her average blood glucose was 147 mg/d and TIR at 92%. The CGM team continued following the patient by phone every 2-weeks and she was seen in the clinic every month. Her CGM Dexcom G6 was changed to Dexcom G7. In the most recent visit in 2023, while utilizing the Dexcom G7, the patient's glucose readings averaged 133 mg/dL, with a GMI of 6.5%, and a TIR of 93%. High and very high glucose levels were at 6% and 1%, respectively, with no reported low blood sugars, and her BMI improved to 26.79 kg/m2. The patient continued her diet, exercise, and regimen of Glucophage 1g twice a day and Empagliflozin 25 mg once daily.

Comment

This case report highlights the remarkable progress achieved through diligent patient engagement, continuous glucose monitoring, and personalized medication adjustments. It exemplifies the transformative potential of CGM technology in optimizing diabetes management and underscores the importance of adapting treatment plans to individual patient needs, ultimately resulting in improved glycemic control and patient well-being.

Discussion

The main purpose of our case study is to show how continuous glucose monitoring can benefit patients with Type 2-DM on multiple injections of Insulin per day. Over the past decade, there have been advances in technology to help monitor our patients' blood sugar levels 24-hours a day 7- days a week. In patients with type 2-DM, this showed superior glucose control and treatment satisfaction and improved quality of life and satisfaction compared to SMBG [16,17,18,19,20]. One of these methods is continuous glucose monitoring (CGM) which is the most important advancement in diabetology in the last 20-years. The use of CGM has been associated with a significant reduction in the HbA1c and hospitalizations secondary to type 1 and 2 diabetic mellitus, as well as a reduction of diabetic retinopathy and albuminuria [15]. It helped us in the internal medicine residency clinic in a process mainly governed by internal medicine and transitional year medical residents under the supervision of board-certified endocrinologists to treat successfully those patients on multiple injections of Insulin per day. By overcoming the glucose toxicity with the use of Insulin and eventually achieving excellent glucose control the CGM team was able to discontinue the Insulin treatment in the 6- cases presented and continue the successful management of the diabetes mellitus type 2 with oral antidiabetic medication with or without injectable GLP-1 receptor agonists. A five-hour postprandial C-peptide was checked while off Insulin and it was normal in all 6 patients described.

Despite this data, many clinics, especially primary care clinics, are reluctant to prescribe these monitors to patients. This may be secondary to unfamiliarity, or cost, to name a few reasons [19]. There have also been multiple studies done that assessed the impact of continuous blood sugar monitoring on the quality of life and overall health of the patients [17,18,19]. Although the initial studies were mostly done in patients with type 1 diabetes mellitus, newer studies showed the same benefit in patients with type 2 diabetes mellitus on multiple injections of Insulin per day [7,8,9,10,11,12]. While endocrinology clinics prescribe CGM often, the same cannot be said about primary care clinics. Many diabetic patients receive diabetes care from primary care clinics and not all have access to endocrinology clinics, especially in rural areas. Some patients must wait months before receiving an appointment with specialty clinics [19].

In our case series, we were able to demonstrate the benefits of CGM in improving the quality of care of patients with type 2-DM on multiple injections of Insulin. By overcoming glucose toxicity, they were able to control their diabetes mellitus with oral diabetic medications with or without injectable GLP-1 receptor agonists and stopping their Insulin. These happened in internal medicine residency primary care clinic and not in the specialized endocrine clinic. The process was governed by medical residents under the supervision of an endocrinologist who was a member of the clinic which as far as we know is described for the first time in the USA.

Conclusion

We successfully introduced CGM in an internal medicine residency primary care clinic and illustrated the concept that with the CGM we can manage successfully decompensated patients with Type 2-DM who were SMBG. We were able to discontinue after overcoming the glucose toxicity of the patients' Insulin without compromising the diabetic control while using only oral diabetic medications with or without the help of GLP-1 receptor agonists. A five-hour postprandial C-peptide was checked while off Insulin in all of the patients and it was normal.

We believe that our valuable experience also improves the education of our internal medicine and transitional year medical residents and can be implemented in other Internal medicine residency clinics in the USA. As far as we know this is the first description of introducing CGM in the USA in the internal medicine residency primary care clinic.

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Conflicts of Interest

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