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(CASE REPORT)

Case report about treatment of the patient with DM Type 2 on multiple injections of insulin who with the help of continuous glucose monitoring (CGM) improved and was controlled only on anti-diabetic pills and GLP1 - RAG

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Abstract

We would like to describe a patient who was treated for decompensated Diabetes Mellitus Type 2(DM type 2) with Multiple Injections of Insulin per day. His HbA1c while when he visited our clinic was above 14 %. He was self-monitoring his Blood sugar at home (SMBG) 4- times a day. He was treated only with Metformin ER in the past. The CGM was started in Internal Medicine Residency Clinic. The patient start sharing his CGM data with the clinic through Dexcom G6 CGM and compatible I phone. The patient was educated on diet, how to adjust his insulin at home based on written instruction material. Moreover, the patient was called at least once a week by the Medicine Clinic professional how to adjust his insulin and to counsel him about his diet and physical activity. The patient had scheduled appointment to the clinic at least once a month.

After the glucotoxicity from the initial high blood sugar was managed by using the appropriate dose of insulin, the insulin dosages started to decrease in our patient. DM type 2 was well controlled with GMI less than 7% after starting the CGM. During the clinic visits, the morning fasting C- peptide of the patient was increased which we attribute due to his morbid obesity. These gave us the opportunity to start the patients on per oral antidiabetic medications and injectable GLP-1 receptor agonists (GLP-1-RAG).

The patient's DM type 2 control was maintained 3-6 months after stopping the insulin with Glucose management index (GMI) which approximates HbA1c less than 7%.

Our experience with this patient showed that introduction of CGM instead of SMBG in the General Internal Medicine Residency Clinic can help patients with DM type 2 to improve their blood sugar control with Insulin and eventually stop the Insulin and start therapy with oral antidiabetic agents and or injectable GLP-1 -RAG. Also, we showed that this can be done safely in General Internal Medicine Residency clinic and not only in specialized clinics.

Keywords: Diabetes Mellitus type 2; Continuous glucose monitoring (CGM); HbA1c; Self-Monitoring blood Glucose (SMBG); C-peptide

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1. Introduction

Diabetes Mellitus is affecting more than 30- million patients in the USA and three time more patients have pre–Diabetes Mellitus. Majority of these patients have Type 2 Diabetes Mellitus (DM type 2) and majority of them are overweight or obese.

Diabetes Mellitus is number one cause of Blindness, end stage renal disease (ESRD) and non-traumatic amputations in USA. It is the main cause of death in these patients with type 2 DM due to macrovascular disease. Treatment of Diabetes mellitus is challenging for the patients and the health care providers. The patients need to learn how to eat right, exercise enough as well to learn about the disease and its treatment. The health care providers- physicians, medical residents, dietitians and diabetic educators need to teach the patients about their diet, physical activity and treatment of their disease. The patients need to change their diet, to start self-monitoring their glucose if treated with insulin and to incorporate at least 150-minutes per week of moderate physical activities to their busy schedule. Recently it has become apparently that patients with Type 2 DM who are taking 3-4 injections of Insulin cannot achieve usually their blood sugar goals with SMBG 4 times a day, rather than by using CGM. The CGM provides every 5- minutes information about the interstitial blood sugar and allows better, more accurate adjustment of the medication for treatment of DM type 2.

The SMBG measured 4 times a day the blood sugar and does not provide the patient and the providers with accurate information about the glucose trends throughout the 24-hour period. Ahead of time management of blood sugar with SMBG is not possible [1,2,3].

CGM is the technology which in the last 10- years had major role in achieving good control on Diabetic patients on multiple daily injections of Insulin [1]. The CGM devices have become smaller and more accurate.

The 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 hyperglycemia and hypoglycemia compared to SMBG in patients on multiple injections of Insulin per day with type 1 and insulin requiring Type 2 DM [4,5,6,7,8].

The first clinical trials compared CGM to SMBG were in patients with Type 1 DM and showed superior results [4,5,6]. More recent studies confirmed these results in patients with type 2 DM [7,8].
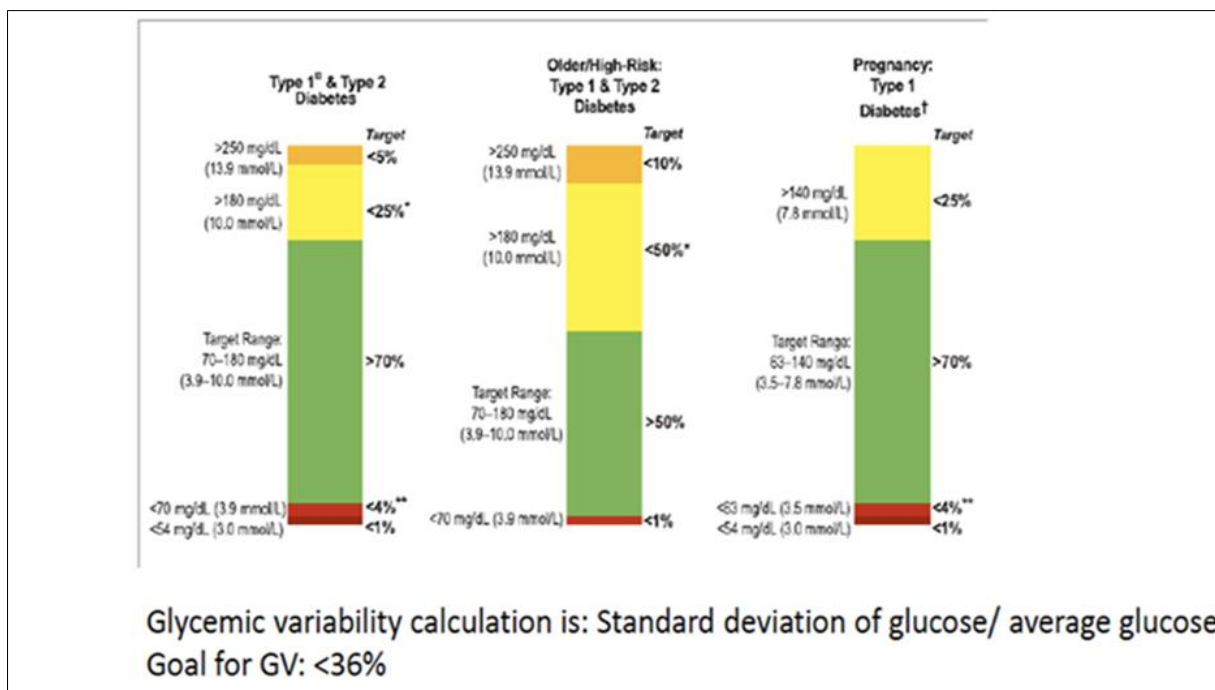

Figure 1 ADA recommendation for the blood sugar goals using CGM

GMI- Glucose management indicator correlates with HbA1c, but does not have the shortcomings of HbA1c like in patients with anemia, End stage renal disease, polycythemia, cirrhosis etc. where HbA1c is inaccurate.

The CGM measure interstitial blood sugar. The measurement is done every 5- minutes. It is transmitted to the receiver or compatible telephone. If the patients have compatible phone, they can share the data of their CGM with the medicine clinic.

The Dexcom- G6 is the preferred CGM nowadays, because it does not require calibration like some other CGM systems.

CGM improves quality of life and psychological wellbeing of the patients. It is also cost-effective compare to SMBG. Current recommendations by American Diabetes Association (ADA) about control of the blood sugar using CGM are described in Figure 1[9,10].

The goal which the patients and providers try to achieve is TIR between 70-180 mg/dl to be around 70% of the time unless the patients are older or pregnant as described in figure 1. TIR is so important, because it showed correlation with development of microvascular complications in patients with diabetes mellitus like retinopathy and development of diabetic nephropathy [11].

We are describing a case with grossly decompensated DM type 2 with HbA1c above 14 who we started on multiple daily injections of insulin in General Internal Medicine Residency clinic.

2. Description of our case

52- year- old African-American male came in our Internal Medicine Residency clinic in the beginning of 2022 because of grossly decompensated DM type 2 with significant, polyuria, polydipsia, and blood sugars at home between 400-500 mg/dl. Measured in our clinic HbA1c was above 14 mg/dl, the blood sugar was 456 mg/dl and the patient did not have ketones in his urine. He was treated before by different clinic with Metformin ER 750 mg/day.

The patient had obesity with BMI of 37.2 kg.m2, HTN controlled with Losartan 50 mg/day, obstructive sleep apnea treated with CPAP and Hyperlipidemia treated with Rosuvastatin 10 mg per day, because of 10 – year -risk for ASCVD of 7%.

The patient was counseled in our clinic about diet with giving him pamphlet with the carbohydrate and calorie content of different foods, instruction to eat 50-60 g carbohydrates per meal and 1800 calories a day. He was instructed to start exercising- 150- minutes per week. He was trained how to inject Insulin as well. In this initial visit to our clinic, we started treating the patient with 4 – injections of Insulin per day - basal Glargine insulin before bed and bolus of Lispro insulin before each meal with the total daily dose of 0.6 Units per kg/day. 50% of the total daily dose (TDD) of Insulin was given as basal Insulin before bed subcutaneously and 50% of the dose was given three times a day (TTD) as Bolus Insulin subcutaneously 15- minutes before his meals. Also, he was given Metformin ER 2000 mg a day.

On his first visit with us with the help of the CGM representative the patient was started on CGM Dexcom G6. The patient was able to share his blood sugar results with our Internal medicine Residency clinic because he had compatible, I phone. The Dexcom representative helped the patient to download the 2- applications- Dexcom and Decom Clarity on that visit to be able see and to share his CGM data with the clinic.

In Internal Medicine Residency clinic, the patient was educated also, how to adjust his insulin dose at home based on his blood glucose readings and how to treat his hyper- and hypoglycemia.

The clinic was calling the patient weekly by Medicine Resident or Attending physician. He was helped how to adjust his Insulin at home once or twice a week. The patient was seen monthly in the clinic. For the treatment of his Obesity the patient was started on extended release Topiramate and Phentermine hydrochloride.

The patient's control of his DM type 2 improved in the next 3- months and his insulin requirements decreased.

On his visit three months later his GMI was 8.2% with average blood glucose of 190 mg/dl. His CV was 35%. TIR -was 52%. High Blood sugar was 40% and very high blood sugar was 8% of the 24-hour period. There was no low or very low blood sugars (BS). In the Clinic was checked his C- peptide which was elevated at that time, because of his Insulin resistance to 7.7 ng/ml. Reference range for the laboratory was 0.8-3.3 ng/ml. At this visit to the Clinic, his bolus Insulin

was stopped and it was started injectable subcutaneously (s. c.) Semaglutide (0.25 mg per week with up titration). We continued the basal Insulin Glargine and Metformin ER.

Three months later his GMI was 7.4%. His average blood sugar was 170 mg/dl, CV was 33%. TIR increased to 64%. High blood sugar was 33 % and very high blood sugar was 3 % of the 24-hour period. The injectable Semaglutide was up titrated to 1 mg s. c. per week. Metformin ER 2 g was continued and it was added Canagliflozin 100 mg a day. The basal Insulin was discontinued.

Two months later on this regimen his GMI was 6.6% and he was continued to be treated by the clinic with per oral antidiabetic medications and injectable GLP1-RAG once a week.

On his last visit in the Autumn of 2022 on the above treatment the GMI of the patient was 6.8% in the last 90- days, Average blood glucose was 148 mg/dl, TIR was 86%, High blood glucose was 14% and there was not very high blood glucose or low or very low blood glucose measurements.CV was 32%. All these parameters showed excellent control of his DM type 2 with the use of CGM and injectable GLP1-RAG- Semaglutide -1 mg s.c. once a week and per oral antidiabetic medications- Metformin ER-2 g a day and Canagliflozin 100 mg a day as well as adhering to the above-described diet and physical activities.

3. Discussion

We described this case to show that the improved glucose control can be achieved by the usage of CGM Dexcom -G6 as well as with appropriate follow up and education of patients. This can be achieved not in specialized Endocrine centers, but in General Internal medicine Residency clinic. This may be adopted by other Internal Residency Programs in USA.

Also, in our case, we found that early intervention and treatment with Insulin with the help of CGM can reverse the glucotoxicity and help the patient with type 2-DM achieve excellent control without the use of Insulin thereafter.

This shows that usage of Insulin in type 2 DM does not need to be for life, but temporary to improve the glucotoxicity and help the Beta-cells of the pancreas starting responding to per- oral antidiabetic medications and GLP1-RAG. This is in contrast to the common notion and fear of patients with type 2 DM that once they start Insulin, they need to be on it for life.

4. Conclusion

This case report will benefit the society of physicians by showing them that early start in decompensated patients with DM type 2 Insulin can overcome Glucotoxicity. By doing this the Insulin cannot continue for life and the patients can switch to per oral antidiabetic medications and GLP1-RAG without worsening of Diabetes Mellitus control. This is against the notion that if the patients with type 2 DM starts on Insulin they should stay on Insulin for ever. Having CGM helps controlling the DM type I and Type II better and starting the CGM can be done in general Internal Medicine Clinic not only in specialized canters. This can be adopted by other Internal Medicine Residency Programs in USA.

Compliance with ethical standards

Disclosure of conflict of interest

There was no conflict of interest of the authors

Statement of ethical approval

This case report involved the human subject and we asked informed consent of his approval of the study and publishing the data to fulfil the ethic requirements.

Statement of informed consent

Informed consent was obtained by all individual participants in the study

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