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CASE STUDY

Rapid Remission of Chronic, Progressive Conditions and Reducing Polypharmacy by Utilizing Lifestyle Therapy to Target Insulinemic Lifestyle Components

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This case study provides evidence that homeostatic control in a patient with hyperglycemia and other metabolic abnormalities associated with insulin resistance can be rapidly restored utilizing lifestyle therapy. The patient, an overweight, non-Hispanic White male aged 70 years, had been medicated for hypertension and Type 2 diabetes mellitus for 12 years. From baseline during 21 months of follow-up, HbA1c decreased from 6.6% to 5.4%, mean fasting glucose decreased from 125 mg/dL to 94 mg/dL, blood pressure decreased from 130/85 mmHg to 100/64 mmHg, estimated glomerular filtration rate increased from 50 ml/min/1.73m^2 to 58 ml/min/1.73m^2, waist circumference decreased from 118.8 cm to 90.8 cm, and liver function improved with aspartate transaminase decreasing from 44 IU/L to 17 IU/L and alanine transaminase decreasing from 34 IU/L to 21 IU/L. Each of these metabolic corrections was observed while eliminating respective disease-specific medications. These metabolic improvements were achieved using primary recommended lifestyle therapy specifically targeting known insulinemic lifestyle components. This case study shows that the utilization of primary recommended, ongoing lifestyle therapy targeting insulinemic lifestyle components can rapidly improve markers of insulin resistance and normalize abnormal laboratory values while eliminating the risk of polypharmacy and the direct costs of medication.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of 4 distinct stages of the dysglycemia-based chronic disease (DBCD) spectrum and is considered a progressive, chronic condition.[1] The joint position statement released by the American Association of Clinical Endocrinologists/American College of Endocrinology clearly states that the scientific evidence supporting these 4 stages (insulin resistance, prediabetes, T2DM, and vascular complications) exist within the context of a single chronic disease.[1] The U.S. Preventive Services Task Force recommends screening for prediabetes and T2DM in nonpregnant adults aged 35–70 years who are overweight or obese.[2] American Association of Clinical Endocrinologists/American College of Endocrinology and other medical associations suggest that lifestyle optimization is essential and recommend that therapy be initiated earlier in the disease stage spectrum.[1,3–5] The American College of Lifestyle Medicine (ACLM) suggests that *complete remission*, defined as

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normalizing glucose metabolism such that HbA1c is reduced to <5.7%, should be the primary clinical goal and is the single greatest need in T2DM care.[5] This case study provides evidence that structured and ongoing lifestyle therapy targeting known insulinemic lifestyle components, as described in detail elsewhere,[6] can reduce disease burden and healthcare costs by achieving complete remission of T2DM and other chronic conditions associated with insulin resistance.

METHODS

Study Sample and Measures

A non-Hispanic White male aged 70 years who was overweight engaged a medical fitness center upon reading marketing material during one of his daily 20,000-step walking sessions. The patient scheduled a complimentary health risk consultation (HRC) with one of the facility's exercise physiologists trained in health coaching.

During HRC, it was determined that the patient was in the action phase of readiness to change.[7] The patient provided a medical history stating that he was diagnosed with and had been started on medications for hypertension and T2DM at the age of 58 years. He had been slowly gaining weight and was having difficulty meeting clinical targets for blood glucose and blood pressure despite adhering to recommended dietary advice, his daily walking sessions, and medication use. The patient's spouse attended the HRC because she was actively involved in his care, meal planning, food shopping, and meal preparation. He described a structured diet on the basis of the teaching from a dietician recommended by his primary care physician. His self-stated personal goals were centered on losing weight while preventing any further health deterioration.

At baseline, the patient presented with all the traditional markers of metabolic syndrome with T2DM. The medical fitness team was able to confirm diagnoses of T2DM, hypertension, chronic kidney disease with proteinuria, and hypertriglyceridemia. Baseline medication list noted 50/1,000 Janumet twice daily (BID), 100 mg losartan potassium once daily (QD), and 25 mg metoprolol BID. The average retail prices of these medications were $736.07 per month or $8,832.84 annually.

At baseline, his blood pressure was 130/85 mmHg, waist circumference was 118.8 cm, BMI was 29.4 kg/m^2, body weight was 90.9 kg, HbA1c was 6.6%, mean fasting morning glucose was 128 mg/dL, high-density lipoprotein cholesterol (HDL-C) was 37 mg/dL, and serum triglycerides level was 241 mg/dL. His estimated glomerular filtration rate was 50 ml/min/1.73m^2, and his estimated 10-year atherosclerotic cardiovascular disease (ASCVD) risk was 40%.

The patient chose to engage in a personalized, team-based medical lifestyle therapy targeting known triggers of hyperinsulinemia and insulin resistance, as described in detail elsewhere,[6] which we hereafter/hitherto refer to as *the therapy*. For a 1-week lead-in period before initiating the therapy, the patient was asked to record premeal blood glucose levels with a detailed food consumption journal, along with 60-minute postprandial blood glucose readings. During the lead-in period, no suggested changes to his diet were made. The patient was instructed to bring 1 complete week of tracking, described above, to his medical clearance appointment, which was scheduled with the supervising physician. This physician assessed the patient's safety to participate in the therapy and created the medication care plan to be used by the lifestyle team.

A review of the food and glucose tracking form from the lead-in period showed that many of the patient's food choices were increasing the blood glucose >40 mg/dL, which was considered a significant glucose increase, from premeal baseline level >100 mg/dL 60 minutes after food intake. Initial 30-day nutritional recall, using Vioscreen, confirmed that the patient's consumption of vitamins D and K were low. Magnesium intake was also low despite the patient taking a daily calcium/magnesium supplement. His dietary carbohydrate intake was 46% of his approximately 3,000 kcal/day intake. Total grams of carbohydrates were 353 g/day, a glycemic load of 185 units. His food choices consisted mainly of potatoes, fruits, desserts such as low-fat frozen yogurt, and snack foods such as whole-grain crackers. Protein was 110 grams/day, 15% of total kcals, which calculates to 1.2 grams/kg for his baseline 90.9 kg body weight. His total fat intake was 135 grams/day, constituting 39% of daily kcals.

At the initial physician consultation, owing to the presentation of the third stage of DBCD, an unprocessed, therapeutic carbohydrate reduction eating pattern, using a low-carbohydrate ketogenic level of reduction, as described elsewhere,[8] was recommended. In anticipation of the reduced need for antihyperglycemic medication and to prevent hypoglycemic events, 50/1,000 Janumet BID was reduced to 25/500 Janumet BID as per recommendations described elsewhere.[8] The initial nutrition coaching session began immediately after this physician consultation. For ongoing nutrition coaching, the patient (with his spouse) met with a registered nurse trained in the use of therapeutic carbohydrate reduction. These 30-minute sessions took place every other week during the initial 12 weeks. Glucose readings, dietary patterns, and challenges or barriers in implementation were reviewed, and any new-onset concerns were addressed. Unlike the nutritional approaches in many of the studies outlined

in the ACLM position statement on T2DM remission,[5] severe calorie reduction was not suggested, and nutrition guidance instead focused on the glycemic and insulin responses of the food choices. The patient was advised to eat to satiety. During the initial 12-week period, the patient and his spouse also met with an accredited metabolic health practitioner every other week for 60-minute classes for T2DM education. These classes covered diabetic medication, insulin resistance, insulin response to macronutrients, disease progression, and other T2DM topics.

Upon initiation of the therapy, each morning, the patient was asked to report body weight, fasting blood glucose, and resting blood pressure to the staff using MedTunnel, a free Health Insurance Portability and Accountability Act—compliant texting app. Any markers outside established care plan ranges were reported to the supervising team physician by staff, and an acute telehealth visit was scheduled.

Patient's baseline cardiorespiratory fitness (CRF) was assessed using a 6-minute walk test at 9.1 MET. His CRF was classified as excellent for a male aged 70 years. Therefore, the patient was encouraged to continue his established walking behavior.

A movement competency screen, as described elsewhere,[9] showed that shoulder mobility, in-line lunge, and deep squat movements were dysfunctional. The other 4 screens showed compensation without dysfunction. Pain was not subjectively mentioned in any of the 7 screens, and referral to physical therapy was deferred. To address movement competency, a correctional exercise prescription was created, and movement competency was considered in resistance training prescription.

Two- or 3-group resistance exercise classes per week were leveraged to complete resistance training prescription. These classes consisted of 60-minute multistation circuits with structured periods of 60 seconds of activity and 30 seconds of recovery. Classes were supervised by exercise physiologists who monitored patient form, queued movement optimization, and made modifications to exercises on a patient-by-patient basis in real time.

During the initial health coaching session, the patient self-reported low life stress, good sleep quantity and quality, and not using tobacco or alcohol. This mitigated the need for substance counseling and, at least initially, any intervention of stress and/or sleep, as per program policy. As for assessing stress and sleep, the program policy is to first improve nutrition and exercise habits when stress and sleep are self-reported as adequate. Subsequently, if nutrition and exercise improvements do not achieve expected metabolic improvements, stress and sleep are then quantified using low-cost, readily available, consumer wearable devices. Specifically, heart rate variability and sleep metrics are the variables that are quantified. These metrics are then used during health coaching to create daily and weekly goals that may improve autonomic nervous system balance, improve sleep quality, and increase sleep quantity.

After the initial health coaching session, subsequent 30-minute health coaching sessions occurred weekly during the initial 3 months and quarterly thereafter. During health coaching sessions, accountability to self-selected goals was assessed, plans to overcome any identified obstacles were created, and goals for the upcoming period were created.

Once laboratory values were gathered, and CRF, movement competency, and nutritional assessments were completed, an initial individual treatment plan (ITP), including notes from the care plan, was created by staff; approved by the director of medical fitness; and faxed to all the patient's medical providers to ensure continuity of care. ITPs were updated every 30 days for the initial 3 months and quarterly thereafter.

Reassessments of CRF, which include weigh-in, resting heart rate, resting blood pressure, and waist circumference were completed each month for the first 3 months of the therapy. Updated laboratory values were gathered, and updates to ITPs were made after all reassessments. Updated ITPs were shared with all the patient's providers.

Statistical Analysis

Because this was a case study of a single patient, no statistical analysis was warranted.

Consent

The patient provided written permission for the use of deidentified personal health information for publication. Institutional Ethics and Review Board approval was not required because this was a retrospective analysis of deidentified data.

RESULTS

Upon adopting lifestyle changes, the patient's fasting blood glucose levels dropped from a mean of 128 mg/dL during the 1-week lead-in period to a mean of 110 mg/dL during the initial week of adopting the new dietary pattern. This result was achieved in the context of the medication reductions noted at the initiation of the therapy. Five weeks after initiation of the therapy, an acute telehealth visit with supervising physician was warranted owing to vitals outside of care plan limits necessitating further polypharmacy deprescription, as described elsewhere.[8] This deprescription of Janumet

Table 1. Baseline, 3-Month, 1-Year, and 21-Month Biometrics, Lipids, Liver and Kidney Function, and Glucose

Measures	Baseline	3 months	1 year	21 months
Medications	100 mg losartan potassium QD 50/1,000 Janumet BID 25 mg metoprolol succinate BID			140 mg evolocumab twice monthly
Biometrics				
Weight (kg)	90.9	78.8	76.7	73.9
BMI (kg/m^2)	29.4	24.8	24.6	23.8
Waist circumference (cm)	118.8	96.5	94	90.8
Cardiorespiratory fitness (MET)	9.1	9.7	9.6	9.8
Blood pressure (mmHg)	130/85	109/73	102/64	100/64
Lipids				
Total cholesterol (mg/dL)	183	197	201	101
HDL cholesterol (mg/dL)	37	45	46	39
LDL cholesterol (mg/dL)	109	132	134	40
Triglycerides (mg/dL)	241	112	106	135
Total cholesterol/HDL (ratio)	4.95	4.8	4.37	2.59
Triglyceride/HDL (ratio)	6.51	3.1	2.3	3.46
Estimated 10-year ASCVD risk	40%	25.1%	25.1%	—
Liver function test				
ALT (IU/L)	44	30	22	17
AST (IU/L)	34	24	23	21
Kidney function test				
eGFR (mL/min/1.73m^2)	50	—	—	58
Glucose				
HbA1c (%)	6.6	5.7	6.1	5.4
Fasting glucose (mg/dL)	128	103	95	94
Dietary pattern				
Total kcals	3,000 kcal	2,050 kcal	—	—
Protein	110 g/day (15%)	162 g/day (32%)		
Carbohydrate	353 g/day (46%)	68 g/day (13%)		
Fat grams	135 g/day (39%)	123 g/day (54%)		
Glycemic Load (units)	185 u	45 u		

ASCVD, atherosclerotic cardiovascular disease; AST, aspartate transaminase; ALT, alanine transaminase; BID, twice daily; eGFR, estimated glomerular filtration rate; HDL, high-density liproprotein; LDL, low-density lipoprotein; QD, once daily.

from 25/500 BID to 25/500 QD was needed because the patient self-reported fasting morning glucose readings were 90 mg/dL−99 mg/dL. Five days later, another acute telehealth visit was warranted because fasting glucose readings were once again being self-reported as 90 mg/dL−99 mg/dL, at which point Janumet was discontinued. Within 6 weeks of beginning the therapy, the patient had achieved a mean fasting blood glucose of 95 mg/dL−105 mg/dL and was no longer taking antihyperglycemic medications.

Initial HbA1c, before the beginning of the therapy, was 6.6% using 50/1,000 Janumet BID. Three months after beginning the therapy, HbA1c was 5.7% without the use of any glucose control medication for 6 weeks of the initial 3-month period. Antihyperglycemia medications were not used for the remainder of the follow-up period (Table 1).

During the lead-in period, before engaging in the therapy, the patient's morning resting blood pressure while using 100 mg losartan potassium QD and 25 mg metoprolol succinate BID was self-reported as a mean of 130/85 mmHg. Blood-pressure medication, 100 mg losartan QD, was halved to 50 mg QD by consulting a physician at the initiation of the therapy. At the first acute telehealth visit, metoprolol was reduced from 25 mg BID to 25 mg QD because blood pressure was being self-reported at <100/70 mmHg. Five days after the first acute telehealth visit (6 weeks after initiation of the therapy), both blood-pressure medications were discontinued completely because the patient was reporting resting morning blood pressure of 95/68 mmHg with associated lightheadedness. Antihypertensive medications were not used for the remainder of the follow-up period.

At 3 months, a second Vioscreen was completed to quantify differences in dietary patterns from baseline. Protein intake increased from 1.2 g/kg (110 g/day) at baseline to 1.8 g/kg (162 g/day) (32% of total kcals). Total carbohydrates were reduced from 353 g/day or 46% of total kcals to slightly over 13% at <70 g/day, a glycemic load of 45 units. At this point, most of his carbohydrate choices consisted of berries, limited fresh fruit, and green leafy and cruciferous vegetables. Virtual elimination of trans fats, a reduction of refined polyunsaturated fats, and an increase in monosaturated fats were observed. Saturated fat consumption remained unchanged. The absolute change in fat consumption decreased from 135 g/day to 123 g/day. This increased fat consumption as a percentage of total kcals from 39% at baseline to 54.3%. Calorie counting and calorie restriction were not prioritized. The patient was taught to eat only when hungry, to enjoy complete meals with minimal snacking, and to eat slowly to satiety. The patient reported naturally dropping his total kcal/day from 3,000 to 2,050 kcals/day owing to improved appetite control.

In 21 months, the patient's BMI dropped from 29.4 kg/m^2 to 23.8 kg/m^2. Body weight decreased from 90.9 kg to 73.9 kg (−17 kg), and waist circumference decreased significantly from 118.8 cm to 90.8 cm. He began the therapy with excellent CRF yet managed to improve his MET maximum from 9.1 METs to 9.8 METs (Table 1). Changes in liver function, kidney function, ASCVD risk, glucose control, medications, dietary kcals, glycemic load, and macronutrient in grams and as a percentage of total kcals are also reported (Table 1).

DISCUSSION

Despite being guideline-recommended first-line treatment, ongoing lifestyle therapy remains underutilized, with <30% of Americans with diabetes receiving any diet or exercise counseling.[10,11] Adjunct and/or general sessions are often ineffective. Structured, ongoing therapy is recommended and is needed to address complex behaviors and conditions. Insulin resistance is the earliest manifestation and the fundamental defect in DBCD.[1,12] Therefore, lifestyle therapy that ignores this target may provide short-term benefits yet fail to achieve a clinically significant reduction in insulin resistance or hyperglycemia.

Before beginning the therapy, the patient's ASCVD risk was estimated using the American College of Cardiology's calculator. At baseline, the 10-year risk for ASCVD was estimated to be 40%, and after 1 year of the therapy, the risk had decreased to 25.1%. Fourteen months after beginning the therapy, the patient's primary care physician prescribed statin therapy as the 25.1% estimated risk was considered high. Statins were not well tolerated, and statin medication was changed to 140 mg evolocumab twice monthly. At 21 months of follow-up, ASCVD risk estimation was not possible because the calculator is unable to estimate risk when total cholesterol is below 130 mg/dL. Whereas low-density lipoprotein decreased significantly, other known markers of CVD risk increased: triglycerides increased by >20% and HDL decreased by >15%, thereby increasing the triglyceride to low-density lipoprotein ratio by >30%.

Limitations

Self-selection bias of a motivated engaged patient exists. More data and longer tracking of patients using this approach are needed to assess the globalization of this case study to larger groups and populations. Further study into the mechanism responsible for the progressive health restoration is needed.

CONCLUSIONS

This case highlights rapid metabolic correction and potential long-term health restoration. These corrections decreased the need for medication and its direct cost (−$8,832.84 annually) while improving the patient's quality of life, appearance, and self-confidence. Progressive restoration of health is possible even in elderly patients whose primary treatment had been medication. By targeting the correct metabolic defect, malignant healthcare utilization[13] and healthcare costs can be decreased.

The entire out-of-pocket cost of the program was paid by the patient: $1,904 for the first year and $1,068 for subsequent years. These prices included acute telehealth visits with the overseeing physician.

The ACLM states that T2DM remission should always be held as the primary goal and that lifestyle medicine interventions that produce changes leading to remission should therefore become the standard of care. Considering the epidemic rise in T2DM in America, adoption of this recommendation should be heeded. Failure to utilize primary recommended, structured, ongoing lifestyle therapies[1,3–5] with the primary goal of complete remission[5] may be a major contributor to disease burden and healthcare costs.[14]

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