ORIGINAL ARTICLE

Dr. Poon's Metabolic Diet Program Improves Clinical and Laboratory Outcomes in Obese Patients with Metabolic Syndrome

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ABSTRACT

Most diet programs should lead to weight reduction. However, for patients with metabolic syndrome (MS), weight reduction is only a part of the goals. The diet program should be able to improve the metabolic markers and the subsequent medical conditions in addition to weight reduction. This study was done to see if Dr. Poon's Metabolic Diet Program can improve the laboratory parameters of patients with MS after they achieve 10% of weight reduction. Blood works were done pre-diet and after 10% weight reduction. Statistical analysis demonstrated that the diet program improves all the parameters of patients suffering from MS. There is no statistical different in patient's renal function test.

Key words: Diabetes, dyslipidemia, fatty liver, hypertension, metabolic syndrome

INTRODUCTION

Obesity, defined as a body mass index (BMI) of 30 or higher, is a serious worldwide epidemic. It is estimated that 39% of adults (18 years or older) in the world were overweight in 2016, with 13% being obese.[1] The obesity rate was 42.4% in the USA in 2017–2018,[2] and a staggering 64% of adults were overweight or obese in Canada in 2017.[3] Obesity is one of the most important risk factors for many medical conditions including type 2 diabetes (T2D), cardiovascular disease, and certain cancers. For patients suffering from obesity and its comorbidities, the treatment of excess weight should be a priority in their medical management.

Dr. Poon's Metabolic Diet Program is a referral-based nutritional program that follows a dietary regimen where the intakes of sugar, starch, saturated and trans-fats, sodium, and ethanol are restricted, shifting the bulk of intake toward protein, healthier fats, and dietary fiber. Potential candidates are assessed for eligibility by a physician during the initial interview; the eligibility criteria include a BMI in the obesity range, as well as the presence of one or more medical comorbidities, such as T2D, dyslipidemia, hypertension, non-alcoholic fatty liver disease (NAFLD), arthritis, and obstructive sleep apnea (OSA). Severe renal and/or hepatic failure is considered contraindications to this program. Once enrolled, patients are expected to comply with the dietary program, which may be individualized according to the patients' circumstances (including medication adjustments) and are directly supervised by clinic physicians during regular follow-up appointments. There are three phases in Dr. Poon's Metabolic Diet plan, with all patients enrolled in the Phase 1 plan at the beginning, and graduating to Phases 2 and 3 based on their patterns of weight loss, as assessed by their supervising physician.[4] In addition to the dietary component, counseling on exercise, food addiction, emotional eating, sleep hygiene, and nutritional label reading are also discussed. The goal is to improve the patients' medical conditions through weight reduction and lifestyle interventions. Program components are constantly monitored and improved.

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The definition of metabolic syndrome (MS) varies depending on the geographic region and academic affiliation, but all involve obesity and some combination of elevated blood glucose, dyslipidemia, and elevated blood pressure (BP). Patients with MS represent a significant subset of obesity that suffers even greater morbidity and mortality, necessitating more aggressive management of their conditions. In this study, we analyzed the effects of Dr. Poon's Metabolic Diet Program on various clinical and laboratory outcomes in those patients with MS who have achieved 10% weight reduction.

MATERIALS AND METHODS

Dr. Poon's Metabolic Diet Clinic has four clinic locations, each with electronic medical records and multiple physicians. Physicians were invited to individually identify eligible patients in their practices from June 2019 to October 2019.

The eligibility criteria for patients were BMI over 30 on initial assessment and at least two of the following four metabolic criteria on initial assessment:

1. Hemoglobin A1c>5.6%
2. Fasting triglyceride (TG) >1.7 mmol/L
3. High-density lipoprotein cholesterol (HDL-c) <1.0 mmol/L for males and <1.3 mmol/L for females, and
4. Systolic BP >120 mmHg and/or diastolic BP >80 mmHg.

Being on medical therapy for any of the four conditions also qualified the patient for eligibility for that diagnosis.

Only patients who had achieved at least 10% loss of their weight at presentation were included in this study.

On initial assessment, if laboratory test results were unavailable, the assessing physician would order these tests. Patients who have been identified to have already lost 10% in weight by June 2019 were also retrospectively enrolled in the study.

Patients were followed at the clinic every 2 weeks on average.

All bodyweight measurements and body impedance analyses were done utilizing the Tanita Body Composition Analyzer TBF-310.[5] Laboratory tests were done in an outpatient setting, through a laboratory of the patient's choosing. The reference ranges of the blood test results were obtained from LifeLabs Medical Laboratory Services.[6]

Patient's age, gender, time to attain 10% weight reduction, and baseline and post-weight loss anthropometric and laboratory data were obtained from chart review. Anthropometric data included weight, BMI, neck circumference, and systolic and diastolic BP. Laboratory data included fasting serum glucose (FBS), hemoglobin A1c, total serum cholesterol, serum TG, serum HDL-c, serum creatinine, serum uric acid (UA), and serum alanine transaminase (ALT). Results before and after intervention were statistically analyzed using a two-tailed Student's *t*-test.

RESULTS

A total of 172 patients from four clinic locations were enrolled in the study, with an average age of 52. About 65% of the patients were female. The mean time needed to achieve 10% weight loss was 11.3 weeks, with a mean loss of 27 lbs or 4.3 kg/m^2 BMI. Not all patients had available both baseline and post-intervention data for each assessed outcome, with the least available being serum UA ($n = 81$).

After achieving 10% weight loss following the dietary program [Table 1], there was a mean 0.9 inch reduction in neck circumference ($P < 0.001$). BP significantly improved post-intervention ($P < 0.001$), with a mean reduction of 16 mmHg and 12 mmHg for systolic and diastolic pressures, respectively. Both FBS and A1c were reduced post-intervention ($P < 0.001$) by at least 10%. Although there was no statistically significant effect ($P = 0.51$) on HDL-c, beneficial effects on total serum cholesterol, TG, and TG/HDL-c ratio were observed ($P < 0.001$). Whereas a decrease of 8 U/L in ALT was observed after weight loss ($P < 0.001$), no significant effects were observed in serum creatinine ($P = 0.65$) and serum UA ($P = 0.98$).

DISCUSSION

One of the objectives of Dr. Poon's Metabolic Diet Program is to treat obese patients who are suffering from MS. Many diet plans can lead to weight reduction. However, if the underlying medical issue associated with MS is not improved by the diet plan, it would not be appropriately therapeutic for this group of patients. This study assessed the effect of Dr. Poon's Metabolic Diet plan on improving metabolic parameters after 10% weight reduction.

Patients took an average of 11.3 weeks to lose an average of 27 lbs of total weight or 2.4 lbs per week. This time frame is comparable to the 11.0 weeks reported previously.[7]

One of the most critical components of MS is insulin resistance and the heightened risk of T2D. Before weight loss, the study group exhibited this risk with an average FBS of 6.4 mmol/L and an average A1c of 6.2%, both higher than the threshold for pre-diabetes (6.0 mmol/L and 6.0%, respectively). The mainstay of risk prevention in MS is lifestyle modification. After 10% weight reduction through the diet, the patients in this study achieved reduced averages of FBS at 5.5 mmol/L and A1c at 5.5%. As an elevated FBS represents abnormal glucose regulation that may progress to T2D, it was reassuring to see FBS decrease in these patients. One critique in this

Table 1: Clinical and laboratory outcomes after 10% weight loss by Dr. Poon's Metabolic Diet Program

Outcome	*n*	Baseline (SD)	After weight loss (SD)
Weight (lbs)	172	245 (54)	218 (48)*
Body mass index (kg/m^2)	172	40.0 (7.3)	35.7 (6.6)*
Neck circumference (in)	114	16.4 (2.0)	15.5 (1.8)*
Systolic BP (mmHg)	150	138 (17)	122 (19)*
Diastolic BP (mmHg)	150	84 (15)	72 (11)*
Fasting serum glucose (mmol/L)	135	6.4 (2.3)	5.5 (0.9)*
A1c (%)	162	6.2 (1.2)	5.5 (0.5)*
Total serum cholesterol (mmol/L)	168	5.0 (1.1)	4.5 (1.1)*
Serum TG (mmol/L)	168	2.11 (1.72)	1.22 (0.53)*
Serum HDL-c (mmol/L)	168	1.25 (0.39)	1.26 (0.35)
Serum TG/HDL-c ratio	168	2.1 (2.4)	1.1 (0.7)*
Serum creatinine (μmol/L)	160	75 (18)	76 (18)
Serum UA (μmol/L)	81	373 (108)	373 (111)
Serum alanine transaminase (U/L)	132	29 (22)	21 (9)*

Data expressed as mean followed by the standard deviation in parentheses. *$P<0.001$. *n*: Sample size; SD: Standard deviation. UA: Uric acid, HDL: High-density lipoprotein, TG: Triglyceride, BP: Blood pressure

context is that identifying patients with impaired glucose tolerance would help improve the sensitivity of predicting the progression to T2D, as it is a better predictor than FBS.[8] Given the prescribed reduction carbohydrates in the patients' diet, the reduction of A1C was not unexpected; this may imply that the diet program may help reduce cardiovascular risk given A1c which is a known cardiovascular disease predictor in both diabetic and general populations.[9]

It is interesting to note that FBS and A1c ranged widely in the patients that met inclusion criteria. It has been established that the FBS is associated with higher risk in coronary vascular disease (CVD) outcomes. The previous studies have suggested a J-shaped relationship between FBS and CVD risk where low FBS was also found to have a higher CVD risk as well. Specifically, FBS levels below 70 mg/dL (3.9 mmol/L) and above 100 mg/dL (5.5 mmol/L) were associated with increased risk.[10] In this study, FBS values before starting the diet program ranged widely, from 4.1 mmol/L at the lowest to 21.5 mmol/L at the highest. After the intervention, FBS ranged by only 5 mmol/L, with the lowest level remaining at 4.1 mmol/L, while the highest reduced to 9.1 mmol/L. These results suggest that the diet program and weight loss narrowed the ranges of FBS without increasing the risk for hypoglycemia (i.e., below 3.9 mmol/L). Changes in A1c also reflected a similar pattern, where A1c ranged by 8.3% before weight loss (4.3%–12.6%), 3.3% after weight loss (4.2%–7.5%). These results demonstrate the diet and resulting weight loss may reduce CVD risk in patients with MS through improving glycemic control.

Hypertension is also included as one of the criteria for MS. The Framingham study is well known as a hallmark study on major CVD risk factors, including hypertension, dyslipidemia, T2D, and smoking. Said study also recognized the atherogenic effect of hypertension, establishing it as a major CVD risk factor, even at the levels of "mild hypertension."[11] Treatment target guidelines have been established and revised over the past few decades, with the most current suggesting in-office BP be below 140/90 mmHg and 130/80 mmHg for those with T2DM. At the initial presentation, the mean of BP in studied patients was 138/84 mmHg. On achieving 10% loss of their weight, the mean BP dropped to 122/72 mmHg, reflecting a decrease of 16 and 12 mmHg for systolic and diastolic BPs, respectively. Readers are reminded that systolic BP is one of the factors involved in the calculation of Framingham Risk Score, an estimator of 10-year CVD risk.[12] Therefore, the observed change in systolic BP values reflects a decrease in CVD risk. A 10 mmHg decrease in systolic BP has been shown to correlate to a reduced relative risk ratio of 0.82–0.87, representing up to 5% decrease in the 10-year CVD risk.[13]

The relationship of obesity on BP control is multifactorial. Biochemical, physiological, and functional studies have suggested that the renin-angiotensin system is crucially involved in the development of hypertension.[14]

For patients on antihypertensive treatment, some have required dose adjustments of their antihypertensive regimen, including diuretics, angiotensin-converting enzyme inhibitors, and angiotensin II receptor blockers. As is clinic protocol, BP readings are taken regularly at follow-up visits, and patients were screened for hypotensive symptoms.

In addition to dietary counseling, counseling on sleep hygiene and stress management may have contributed to observed reductions in BP also. Stress, whether physical or psychological, can increase BP by increasing cortisol, angiotensin, and adrenocorticotropic hormone secretion.

T2D and hypertension are two parts of MS that can contribute to renal dysfunction. The serum creatinine level is a useful screening test to assess renal function. Therefore, this study studied the serum creatinine values before and after weight loss to ensure safety with respect to renal function.

Creatinine is a breakdown product of serum creatinine phosphate from muscle and protein metabolism, is released at a constant rate by the body, and will vary between individuals depending on their muscle mass (although it may be affected, to a smaller extent, through meat consumption).[15] Creatinine is, therefore, a surrogate marker of skeletal muscle mass in addition to being an indicator of renal function.[16] In our clinical application, the serum creatinine level is thus used as one tool to estimate the body's lean muscle mass. Data reveal that the mean serum creatinine at presentation was 75 μmol/L, compared to 76 μmol/L after weight loss ($P = 0.645$). This is reassuring, as this diet program, which is higher in protein content, likely does not adversely affect renal function. However, as creatinine reflects muscle mass as well, changes in the patients' muscle mass may have also contributed. Nonetheless, the preservation of muscle mass is emphasized in the program through the encouragement of patients to engage in regular physical activity.

Using only the total serum cholesterol level to assess the cardiovascular risk lacks specificity. Research has identified the low-density lipoprotein cholesterol (LDL-c) as part of the total cholesterol level that increases the CVD risk, whereas HDL-c is cardioprotective. The total cholesterol to HDL-c ratio was introduced recently to increase the predictive value of the lipid profile. Lipid particle sizes have been implicated in the progression of the atherosclerotic plaque with smaller and denser LDL-c particles being more atherogenic than larger LDL-c particles. Similarly, larger HDL-c particles are also less atherogenic than the smaller, denser HDL-c particles. However, the measurement of the lipid particle size is used more frequently as a research tool and is not practical for clinical use. The ratio of TG/HDL-c, however, correlates inversely with the smaller, denser LDL-c particles. Thus, the lower the TG/HDL-c ratio, the lower the CVD risk.

The reference range for TG/HDL-c ratio is generally understood to be lower than 1.7.[17] The average TG/HDL-c ratio before the diet was 2.1 (higher than the reference range), but after weight reduction, the figure had gone down to 1.1. The main reason for the improvement was due to the improvement of the TG level, which lowered from 2.11 to 1.22 mmol/L ($P < 0.001$), whereas HDL-c did not show any significant change ($P = 0.505$). TG is an independent risk factor for arteriosclerosis,[18] and high TG can be attributed to the elevated intake of sugar, simple carbohydrates, saturated fat, and ethanol. The diet program specifically prescribes restriction in sugar starch, and bad fat which likely contributed to the reduction in serum TG, which ultimately lowered the TG/HDL-c ratio.

Hyperuricemia, NAFLD, and OSA are also conditions associated with MS; UA, ALT, and neck circumference were monitored in this study for this reason.[19]

Each patient's neck circumference was measured instead of waist circumference, not only due to the former being predictive for OSA. Since an accurate measurement of waist circumference is difficult, due to difficulties in locating the anatomical landmark (upper margin of the iliac crest) and the requirement for the patient to be in a state of undress. Although waist circumference can also be useful to assess adiposity in the overweight patient, this is made redundant due to the use of body impedance analysis. Healthy neck circumference cutoff is defined as equal to or <15 and 14 inches in males and females, respectively. Men whose neck circumference is 17 inches or greater and women whose neck circumference is 16 inches or greater are specifically at higher risk for OSA.[20] The average baseline neck circumference in this study was 16.4 inches, which was lowered to 15.5 inches after weight reduction. Despite the results showing improvement in neck circumference, most patients did not reach the healthy neck circumference cutoff after 10% weight loss. As OSA can contribute to hypertension, improvement in neck circumference may represent another avenue in which better BP was achieved in the studied patients.

UA is not as a formal component of MS, but its association with MS is well documented.[21-23] UA level in the patients was markedly heterogeneous, ranging from 70 to 613 mmol/L; the upper reference range is 390 mmol/L. Common complications of high UA are gout and kidney stones. Given that Dr. Poon's Metabolic Diet Program allows the patient to consume large amounts of lean protein, including red meat, many patients with a history of hyperuricemia, gout, or kidney stones, may hesitate to follow this diet recommendation. However, high UA can also be attributed to diuretic use, ethanol consumption (especially beer), hypothyroidism, chemotherapy, and fructose intake.[24] Although this diet plan allows patients to eat meat and seafood, patients are not allowed to consume any form of ethanol in Phase 1 and are instructed to limit food high in sugars, such as fruits, juice, and desserts. Data show the pre-diet and post-weight loss; UA levels are similar, suggesting that the negative effect of a high purine diet can be potentially balanced by other dietary interventions, including a reduction in fructose and ethanol. Patients on this diet are also advised to limit added sodium in their diet to improve BP control, after which point antihypertensives such as diuretics can be discontinued.

The most common cause of a modest elevation in ALT level is NAFLD. There are many causes of fatty liver, including ethanol overuse; NAFLD causes include MS, medication side effect, and high fructose consumption. The upper limit for serum ALT is understood to be at around 36 U/L, meaning 17% of our patients had ALT transaminitis pre-intervention. After 10% weight reduction on the diet program, this percentage reduced to 5%. There is a significant drop in the average ALT from 29 U/L to 21 U/L ($P < 0.001$). The improvement in ALT in the majority of patients is likely attributed to the prescribed reduction in fructose and ethanol intake.[25]

CONCLUSIONS

This study demonstrated a strict diet regimen limited in sugar, starch, saturated fat, and sodium was successful in reducing the weight of obese patients with MS, significantly improving all the aspects of MS except HDL-c. Reassuringly, the TG/HDL-c was lower with the TG reduction, lowering the risk of insulin resistance, and CVD. With the relatively higher protein intake, markers for liver and kidney function were closely monitored. Using ALT as an indicator of liver inflammation and hepatocellular damage, the values were, in fact, lower with weight reduction on this diet while creatinine remained stable and unchanged through the study. Thus, the MS patients participating in Dr. Poon's Metabolic Diet Program showed benefits in both clinical and laboratory outcomes after achieving 10% weight reduction. Accordingly, this shows that a focused and direct treatment of excess weight through dietary and other lifestyle changes should form an integral part of the management in obese patients with MS.

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