Pilot Study: Anti-inflammatory Diet and Stress Reduction Techniques to Improve Glucose Control

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Abstract

Objective: To evaluate the effect of an anti-inflammatory diet and stress reduction techniques on quality of life, emotional eating and objective markers of stress.

Methods: 18 subjects were enrolled in a 6 week lifestyle intervention program including instruction in anti-inflammatory cooking and meal plan, physical activity (30-40 minutes at least 5 times/week), and stress reduction techniques. Heart rate variability, quality of life, psychosocial questionnaires, and cortisol levels were evaluated at baseline and upon completion of the 6-week intervention. Salivary cortisol and cardiac sympathetic coherence were also measured at baseline and post-intervention.

Results: Heart rate variability (coherence) improved significantly during the 6 week intervention (39% pre-intervention vs. 74% post-intervention, p<0.01). Significant improvement was seen in the SF-36 quality of life measurements for the following assessments: Role Limitations due to emotional the score (54.6 vs. 83.3, p<0.03), Vitality (48 vs. 54, p<0.04), General Health (61.3 vs. 67.1, p<0.02) and Mental Health component (41.3 vs. 48.4, p=0.037). There was significant improvement in the Beck Depression inventory (10 vs. 5.8, p=0.05) and the Eating Disorder Disorder Scale (9.4 vs. 5.9, p=0.02). Salivary cortisols showed a reduction in the morning, noon and evening samples, but only the noon sample reached statistical significance (p=0.04).

Conclusion: This short term practice of stress reduction and anti-inflammatory diet techniques produced significant improvements in heart rate variability, salivary cortisol levels, emotional eating, depression and overall quality of life among participants, and could represent a simple, cost-effective adjunct to conventional lifestyle modification in managing T2DM. A larger study is planned to investigate the impact of these techniques on glucose regulation in patients with poorly controlled type 2 DM.

Introduction

It has been estimated that 11.3 percent (25.6 million) of the U.S. population age 20 years or older has type 2 Diabetes Mellitus (T2DM) (1), and despite the enormous investment in treatment intervention, the prevalence of diabetes mellitus continues to increase. Chronic stress, both physical and emotional, is known to increase stress hormones such as cortisol, and increase the inflammatory response and oxidative stress, which, in turn, increases insulin resistance and the risk of cardiovascular disease (2, 3). Current large scale interventions have improved glucose control, emotional status and quality of life in patients with T2DM through modifications in diet, physical activity and peer support (4, 5). However, the impact of stress on treatment outcomes and the value of stress reduction techniques and an anti-inflammatory diet in managing T2DM have not been evaluated.

Methods

Study participants completed a series of questionnaires to assess anxiety (STAI-G, STAI-I), depression (Beck Depression Inventory-II), quality of life (SF-36), Physical Activity Readiness, eating patterns (Eating Disorder Disorder Scale), and completed an assessment of physical strength, balance, and walking speed at baseline and upon completion of the 6-week intervention. Salivary cortisol and cardiac sympathetic coherence were also measured at baseline and post-intervention.

Inclusion Criteria:

- Minimum 18 years of age
- Male or female
- Type 2 DM or Prediabetes
- BMI<35
- Able to participate in physical activity program

Exclusion Criteria:

- Severe diabetes neuropathy or chronic kidney disease
- Emotional instability (severe depression, psychosis)
- Active substance abuse
- Anti-hypertensive drugs
- Beta-blocking agents
- Use of exogenous steroids

The SF-36 quality of life results show that patients achieved significant improvements in their ability to manage emotional stress (56.6 vs. 85.3, p=0.03), improved vitality (48 vs. 54, p=0.04), mental health (43.1 vs. 48.4, p=0.037) and general health (61.3 vs. 67.1, p=0.02) despite the short duration of this intervention, along with improvements in Beck Depression inventory scores (10 vs. 5.8, p=0.05) and binge eating (9.4 vs. 5.9, p=0.02).

We observed significant improvements in heart rate variability (Coherence) across all study periods. The mean baseline cardiac coherence was 39.07%, post-intervention mean was 74%, p =< 0.01. A small but significant reduction in resting heart rate was also observed in this study (75 vs. 71 bpm, p = 0.031).

Discussion/Summary

This short-term feasibility study confirms our ability to successfully implement each of the lifestyle intervention components planned for a larger scale comprehensive intervention, and holds promise that we may find positive outcomes in our main study.

Despite the small group of subjects and short duration of our program, we noted significant results. The marked improvement of quality of life and other psychosocial questionnaires was striking for a program duration of only 6 weeks. The result of cardiac sympathovagal coherence were also dramatic, indicating that these interventions are an effective tool to reduce stress, improving sympathetic tone and improving quality of life.

It was interesting to see reductions in salivary cortisol levels in response to stress reduction techniques and larger studies are necessary to determine what factors contribute to cortisol levels, stress reduction and lifestyle interventions outlined in this pilot study.

Management of T2DM is often made more difficult as result of stress-induced binge eating. In our small study, the use of stress reduction techniques resulted in significant improvements in both depression and binge eating over the 6 week intervention. We expect to see an impact of these behavioral changes on glucose control at a larger scale.

The literature suggests intriguing associations between stress, inflammation and insulin sensitivity, but only limited investigations have explored the key factors to improve T2DM management. Furthermore, despite evidence that an anti-inflammatory diet, exercise, and stress reduction can each improve glucose control, no study has tested whether combining these interventions has a greater cumulative benefit in managing T2DM than traditional diet and exercise alone.

The long term goal of our research is to improve management of T2DM, while improving the quality of life for patients. The objective of this research endeavor is to determine whether implementation of stress reduction strategies and an anti-inflammatory diet could offer an inexpensive, effective addition to the current management of T2DM. We are interested in evaluating the effect of these interventions on indicators of glucose control, insulin resistance and inflammation such as glycosylated hemoglobin (HbA1c), homeostatic model of insulin resistance (HOMA-IR), continuous glucose monitoring (CGM) with calculation of mean amplitude of glycemic excursions (MAGE), urinary 6-isoprostaglandin F2-alpha (6-8), and C-reactive peptide and possibly other biochemical markers.