Effects of Apple Cider Vinegar on Postprandial Glucose Levels in Adults with Type 2 Diabetes

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Introduction

- Increasing numbers of individuals with chronic conditions are turning to complementary and alternative medical (CAM) practices.
- 48% of diabetic patients utilize complementary and alternative medical (CAM) practices.
- Efforts should be made to find the most effective and safe options for patients. In particular, the public is interested in the use of vinegar to reduce postprandial glycemia (PPG).
- The ADA recommends that patients take steps to reduce postprandial glucose levels to decrease complications such as cardiovascular disease.
- Initial research into the use of vinegar to reduce postprandial glucose levels suggests it may be effective.
- Possible mechanisms of action:
  - Delay gastric emptying.
  - Inhibit digestive enzymes (similar to the prescription alpha-glucosidase inhibitors).
- Previous studies contain multiple flaws including small samples sizes, inclusion of patients taking other hypoglycemic agents, and poor study design.

Hypothesis

- Ingestion of apple cider vinegar before a meal will reduce postprandial glycemia in adults with type 2 diabetes leading to better blood glucose trends.

Specific Aims

- To determine whether ingestion of apple cider vinegar with a meal will reduce postprandial blood glucose in individuals with type 2 diabetes by measuring blood glucose levels 2 hours after the meal.
- To assess the change in glucose trends in patients who begin consuming apple cider vinegar with meals using a continuous blood glucose monitor.

Methods

- The study design will be a double-blind, randomized, crossover trial. Each subject will receive both placebo (3 weeks) and apple cider vinegar (3 weeks) over the 7 week trial.
- All prescription medications including hypoglycemic medication will be kept stable through duration of study and will be recorded.
- This study will be conducted at each patient's home. Patients will be responsible for recording food intake, blood glucose levels, and exercise. Patients will be provided a 7 day supply of breakfast and study drink on each Monday of the trial.
- Regulated evening meal will consist of protein, whole grain, non-starchy vegetable, and 60 grams of carbohydrates.
- Standard breakfast= 1 white bagel, a tablespoon of butter, and an 8 oz container of Tropicana orange juice over 15 minutes.
- Placebo drink= water to 40 g, sweetened with 1 teaspoon saccharine and colored with 1 drop food color.
- Active drink= 2 tablespoons apple cider vinegar diluted with water to 40 g, sweetened with 1 teaspoon saccharine and colored with 1 drop food color.

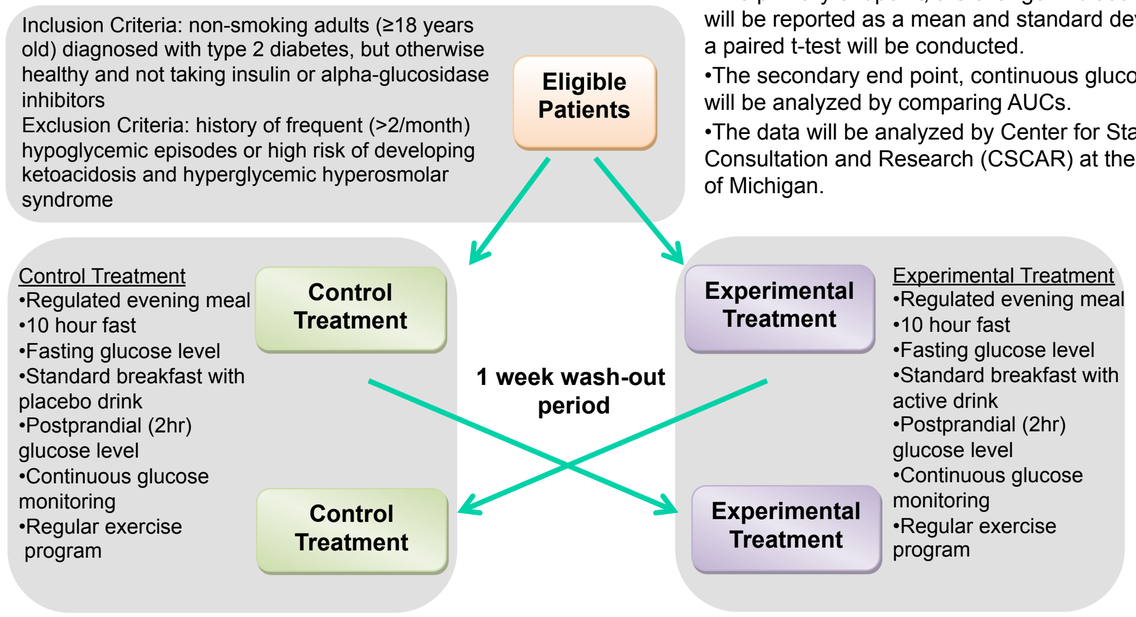

Figure 1: Summary of Study Methods

Data Analysis

- A total sample size of 68 patients for a power of 80% and a level of significance of 0.05.
- The primary endpoint, the change in blood glucose, will be reported as a mean and standard deviation and a paired t-test will be conducted.
- The secondary end point, continuous glucose trend, will be analyzed by comparing AUCs.
- The data will be analyzed by Center for Statistical Consultation and Research (CSCAR) at the University of Michigan.

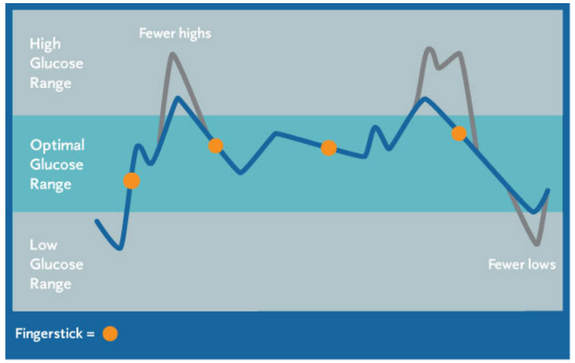

Figure 2: Expected results of continuous glucose monitoring

Conclusions and Limitations

- Type 2 diabetes is a prevalent disease in our society and many patients are interested in alternative methods for controlling their disease.
- This study hopes to show that two tablespoons of apple cider vinegar will reduce PPG and improve glucose trends.
- The most likely limitation of the study is the natural variation in blood glucose levels within an individual.
- To minimize this effect the evening meal, fasting time, exercise, breakfast, and treatment suspension will be controlled.

Future Direction

- If positive findings or trends are observed the A1C will be assessed to determine long term efficacy.
- Once utility has been established alternative dosage forms will be identified.

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