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Commentary
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Potential Benefit of Postprandial Exercise for Those with Type 1 Diabetes

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Introduction

Currently, less than one-third of individuals with type 1 diabetes are considered to be in good glycemic control with an A1C <7%, increasing the risk of short- and long-term complications [1]. Considering the annual cost of type 1 diabetes care to the individual, estimated to be $6,288 per year in a 2010 paper [2] and the increasing price of insulin [3], effective and realistic low/no cost strategies to improve glycemic control are needed not only to reduce the expense to the individual with type 1 diabetes, but also to prevent the short and long term complications of poor glycemic control and minimize the negative consequences of high insulin dosages, such as possible weight gain [4].

The Glycemic Effect of Postprandial Exercise

Because exercising muscle does not require insulin for glucose uptake [5], postprandial physical activity may blunt the spike in BG and overall glycemic response to carbohydrate ingestion, potentially resulting in better BG control and decreasing insulin dosages needed. Studies with healthy participants and those at risk for type 2 diabetes have shown beneficial effects of postprandial exercise on the glycemic response to food [6-10]. Few studies have been conducted examining the effect of postprandial physical activity on the glycemic response in individuals with type 1 diabetes.

Postprandial Exercise and Type 1 Diabetes

Four studies have examined the effect of postprandial exercise on the glycemic effect of a meal in individuals with type 1 diabetes, and each found a beneficial effect [11-14]. Three of the studies were published between 1982 and 1994, before intensive insulin therapy was commonly used by those with type 1 diabetes to control BG. Nelson, et al. [11] used a closed loop artificial endocrine pancreas to control BG in 9 subjects with type 1 diabetes. When subjects cycled for 45 min at 55% max HR commencing 30 min after consumption of a breakfast, 30% less insulin was infused by the artificial pancreas compared to the control day, when subjects did not exercise after eating. When a fixed open loop infusion rate was used in 4 subjects, hypoglycemia occurred on the postprandial exercise day, but not on the control day. In another 1982 study, 8 subjects were housed in a clinical investigation unit to determine the effect of 45 min of cycling 30 min postprandial from the start of breakfast [12]. Normal BG was maintained overnight via IV insulin infusion before data collection days. Thirty minutes before breakfast, subjects injected themselves with their usual insulin types and dosages, which included varying combinations of Lente, Regular, and NPH insulin, and the IV insulin infusion was stopped 15 min before breakfast. Peak BG was significantly lower after both breakfast and lunch on the exercise day compared to the control day. Thus, this study indicated that postprandial exercise could influence the glycemic response to the meal consumed after the exercise as well as the glycemic response to the meal consumed before the exercise.

In 1994, Rasmussen and coworkers found favorable effects of 30 min of cycling at 65% VO2 max that commenced 15 min after consumption of a 50 gm carbohydrate load in 7 subjects with type 1 diabetes [13]. In this study, participants' BG was maintained in a normal range for 2 hour prior to meal, followed by continuous insulin infusion for the remainder of data collection. The exercise significantly decreased the glycemic response to the meal by 34% ± 12% (P<0.01), although peak BG did not differ between the exercise and control days.

In 2002, researchers found a similar beneficial effect of postprandial physical activity in subjects on an intensive insulin therapy that differs from intensive insulin therapy regimens used today: 6 healthy subjects with type 1 diabetes received an injection of Regular insulin 30 min before each of 3 meals and an injection of NPH insulin in the evening in a hospital setting, but the participants were given a bolus of regular insulin 30 min before meal consumption [14]. BG levels were stabilized in all subjects within 3-5 days, at which time data collection commenced. In addition to a control day, subjects walked for 30 min at <50% maximal oxygen uptake and consumed breakfast 30 min afterward. On another day, subjects walked for 30 min at the same rate after breakfast. The area under the glucose response curve was significantly lower (P=0.043) when subjects exercised after breakfast compared to the control day. Exercising before breakfast resulted in no difference in the glucose response curve compared to the control day. Thus, exercising after meal consumption appears to be more effective than exercise before meal consumption in those with type 1 diabetes when on an insulin regimen that consists of Regular insulin before meals and NPH in the evening.

Considerations

With cautious BG monitoring or the use of a continuous glucose monitor along with being prepared to make a correction in BG if needed, individuals with type 1 diabetes can safely partake in physical activity, avoiding hypo- or hyperglycemia [15,16]. Since exercising muscle and insulin have a synergistic effect on facilitating BG uptake by muscle cells, those administering insulin with meals and performing physical activity right after food consumption could be at increased risk for hypoglycemia. The effect of a shorter duration of postprandial activity than the studies described in this article may reduce the risk, and should be investigated.

In addition to glycemic control, exercise is recommended by the American Diabetes Association for individuals with type 1 diabetes to promote overall health and decrease the risk of health problems such as CVD and obesity [17]. With the liberalization of the diet for those with type 1 diabetes made possible with intensive insulin therapy, the combination of increased food intake and increased daily insulin dosages has contributed to an increase in the prevalence of obesity in this population [4,18]. Thus, despite the concern of hypoglycemia with exercise, physical activity is important for many reasons in this

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population, including prevention of chronic disease, weight control, and glycemic control, and can be performed safely by individuals properly educated on BG monitoring and preparations in the case of exercise-induced hypo- or hyperglycemia.

Summary

Achieving good glycemic control for those with type 1 diabetes is important to prevent or delay complications from diabetes and improve quality of life. With mounting evidence, health professionals may consider recommending postprandial physical activity to their patients to optimize glycemic control, not only to improve health, but also as a no-cost treatment modality that has the potential to reduce medical costs associated with diabetes.

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