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From Research to Practice/ Medical Nutrition Therapy

Carbohydrate Counting: A Return to Basics

Carbohydrate Counting for Athletes

Ann Albright, PhD, RD

Carbohydrate counting is a useful approach to meal planning for competitive or casual athletes. Consider the following two examples.

Case #1
R.J. is 25 years old and has had type 1 diabetes for 6 years. About 3 years ago, he went on an insulin pump and has been using carbohydrate counting to determine his insulin boluses. His current carbohydrate-to-insulin ratio is 10 g of carbohydrate for 1 U of insulin. An avid runner for approximately 5 years, R.J. usually reduces his insulin dosages on training and competition days.

R.J. currently averages 25–30 miles of running per week. He has competed in several 5- and 10-kilometer races and has decided he would like to begin competing in marathons. He needs assistance with how to modify his food intake as he increases his mileage for training, as well as how to consume carbohydrate during a marathon.

During R.J.'s daily training, he is consuming 8–10 g carbohydrate/kg body weight/day. During the week before the marathon, he is doing a modified glycogen supercompensation plan described below that results in carbohydrate consumption between 5–10 g carbohydrate/kg body weight/ day with a tapering exercise duration. Carbohydrate intake during the marathon is between 40 and 65 g/hour, and within 24 hours after the marathon, R.J. resumes his intake of 8–10 g carbohydrate/kg body weight /day. Frequent monitoring of blood glucose is imperative to make necessary adjustments in carbohydrate intake and/or insulin.

Case #2
S.H. is 16 years old and has had type 1 diabetes for 3 years. She is currently on three injections of insulin per day and is trying to follow a general "healthy eating" meal plan that she was given at diagnosis. She is on her high school soccer team and has after-school workouts or competitive matches 5 days per week. She also has periodic matches on weekends.

S.H. needs assistance with learning to make any necessary adjustments in food intake during soccer practice and competitions. In addition, she would benefit from reassessment

during soccer practice and competitions. In addition, she would benefit from reassessment of her current meal plan and learning how to count carbohydrate.

The carbohydrate-to-insulin ratio that S.H. found worked the best was 15 g of carbohydrate for 1 U of insulin. She consumes approximately 75 g of carbohydrate at each meal with additional carbohydrate immediately before, during, and/or after soccer games depending upon blood glucose readings and anticipated playing time.

The patients described above are examples of the athletes typically seen in my work as an exercise physiologist and dietitian. While my clinical work in diabetes has certainly not consisted solely of diabetic athletes, working with those who are increasing their level of exercise is very common. Since work with competitive or recreational athletes who have diabetes, like other special populations, requires some specialized knowledge, I also have several opportunities to consult on patients being seen by colleagues.

When beginning to work with diabetic patients who are currently participating in athletic events or who are planning to do so, it is imperative to do a thorough initial assessment. The first patient visit is done as an individual appointment that lasts for about 45 minutes because it is necessary to get detailed information about the athlete that is best accomplished in a one-on-one setting. This assessment, as for any patient, must include a review of the patient's history that identifies any medical concerns (e.g., serious episodes of hypoglycemia, presence of any chronic complications), review of labs, current blood glucose monitoring frequency and results, and dosage and timing of medications (including carbohydrate-to-insulin ratio if currently using an intensive insulin regimen).[1]

At the initial visit, a thorough food and exercise recall is also taken. Patients are asked to describe what they are currently doing in as much detail as possible. It is not uncommon for those who are involved in competitive athletic events to bring written records about their training regimens to the initial visit. If these records are available, they are discussed with the patient to be sure the information is complete. It is important to get information about both training and competitions.

For patients already using carbohydrate counting as their nutrition tool, such as R.J. in case #1, a brief practice session is conducted using food models to determine where they stand with estimating food portions. It is important to assess their current ability since this is a critical skill for successful carbohydrate counting. An assessment is also done of their ability to read and use food label information and where they turn for carbohydrate information if a label is not accessible.

Depending on a patient's skill level in these areas, more work may be done on these at the next individual appointment or in a class setting. It is often desirable to teach and practice label reading and carbohydrate estimating in a group setting because patients can learn from and reinforce each other.

For patients who do not use carbohydrate counting, such as S.H. in case #2, it is important to determine if they use any nutrition approach and, if so, how well it is working. While carbohydrate counting is not the tool for everyone, it is a very useful approach for athletes because of the need for significant flexibility with training and competitions. If an athlete is

because of the need for significant flexibility with training and competitions. If an athlete is amenable, the basics of carbohydrate counting (e.g., what foods contain carbohydrate, where to get carbohydrate information) are taught at the first visit, and an initial carbohydrate-to-insulin ratio is established based on the patient's nutrition and exercise history. At subsequent appointments, blood glucose records are used to assess and modify the carbohydrate-to-insulin ratio, and opportunities to refine skills in estimating carbohydrate portions are provided.

Carbohydrate counting for athletes has application in several settings: during daily training, for the week before a competitive event, in the preceding hours before competition, during competition, and in the 24 hours after competition.[2] For each of these time periods, appropriate carbohydrate and insulin dosages must be determined to maximize performance and keep blood glucose levels within the patient's therapeutic goals.

In addition to refining skills in carbohydrate counting, the subsequent appointment(s) are spent carefully reviewing training, blood glucose, and food records to help athletes achieve their competitive and blood glucose goals. A variety of other topics are also discussed that have relevance to food and athletic performance and may include such issues as use of and response to sports bars and carbohydrate beverages. Diabetic athletes can derive important benefits from the use of sports bars and carbohydrate beverages since supplemental carbohydrate is often necessary to maintain exercise intensity and, for those with diabetes, to prevent and/or treat hypoglycemia. The follow-up with patients is often accomplished via telephone and fax, particularly as the competition draws closer, when more frequent contact is desirable.

The expectations for what patients should know as a result of education sessions depends on their initial knowledge and skill level. Athletes who already have fairly high carbohydrate counting knowledge and skills should be better able to apply that knowledge to a wider array of circumstances, such as increasing mileage during a training session or in variable competition settings. When carbohydrate counting is being taught to athletes for the first time, it is important that they can successfully identify carbohydrate-containing foods and work to fine-tune their carbohydrate-to-insulin ratio.

It is important for all athletes to keep careful records so that we can work together to increase their ability to make decisions in the variable situations in which they find themselves. For all athletes, a great deal of trial and error occurs as they work to balance food and exercise. It is therefore important to reinforce good efforts and sound logic used as athletes work to compete and keep diabetes in balance.

The primary advantage for using carbohydrate counting with athletes is the flexibility it provides. It is necessary to have a nutrition approach that helps diabetic athletes meet treatment goals and allows significant flexibility due to the variety of circumstances that can arise while training and certainly while competing. By using a technique that can be applied in numerous settings, athletes can learn the necessary skills for carbohydrate counting and then modify the specific application of this information as they train and compete. When compared to other nutrition approaches, carbohydrate counting provides a greater degree of accuracy for making insulin dosage adjustments. This is also a very important advantage

for athletes because they must have adequate fuel available for increased activity level, while at the same time prevent hypo- and hyperglycemia. Because of the more complex set of circumstances seen in athletic events (stress of competition, variable timing of competitive events, and duration of energy expenditure), use of a nutrition approach that allows the greatest accuracy available is recommended.

Every nutrition approach has its limitations because food issues are often the most complex and challenging that patients face. If carbohydrate counting is to be done with the greatest accuracy possible (which is not perfection), it is important to learn to accurately estimate portions. This is a skill that many find to be very challenging and one that requires practice. In addition, if a food label is not available, it is necessary to determine the amount of carbohydrate in the serving using other sources of nutrition information that may not be readily available (e.g., food lists). Another challenge with carbohydrate counting is the use of calculations to determine the units of insulin needed for a given amount of carbohydrate. This can pose difficulties for patients.

While these features of carbohydrate counting can be considered limitations by many, including athletes, they are outweighed by the advantages. The flexibility provided by carbohydrate counting is a necessity when working to achieve success in athletic endeavors and maintain appropriate blood glucose control. The limitations of carbohydrate counting are likely to be less limiting for athletes since they may be more accustomed to performing calculations, estimating food quantities, and keeping careful records as a part of training for athletic events.

Teaching strategies that can be helpful when working with athletes provide patients with opportunities to apply their knowledge and skills. Creating food choice scenarios based on patient experience (obtained from the history) that are worked through together helps prepare patients to troubleshoot on their own. For example, one could ask an athlete who is preparing for a marathon what he will do 3 days before the event to help increase glycogen levels while working to keep his blood glucose in check.

It is important to caution athletes with diabetes about using glycogen supercompensation regimens. A strategy reported by Sherman et al.[2] incorporates dietary manipulation and tapering of exercise duration 6 days before the competition to achieve glycogen supercompensation. During the first 3 days, the diet should contain 5 g carbohydrate/kg body weight/day, and during the last 3 days, 8–10 g carbohydrate/kg/body weight/day. Moderate exercise should be done at diminishing duration of 90, 40, 40, 20, 20, 0 minutes over the 6 days. This regimen increases muscle glycogen to more than 210 mmol/kg wet wt. (approximately 1.6-fold above usual glycogen concentration).

It is also important to discuss what food choices will be made within the hours preceding exercise. One study demonstrated that a low-glycemic- index meal (totaling 1.5 g carbohydrate/kg body weight) produced significantly higher plasma glucose levels, lower insulin levels and ratings of perceived exertion, and 59% longer time to exhaustion than a high- glycemic-index meal.[3] This study was not conducted in those with diabetes, so the application to this special population is unknown.

These practice scenarios also let clinicians see if patients' logic is sound and allows reinforcement of information that patients need to make appropriate decisions. The records kept by patients on food intake, training schedules, blood glucose monitoring, and insulin dosages are especially important for athletes. A greater degree of information is necessary when working with this special population in order to help patients exercise safely and achieve their athletic goals. It is imperative that patients make a commitment to keeping good records and that clinicians and patients use this information to guide carbohydrate decisions.

Although not a teaching strategy provided directly by clinicians, it is important to help athletes with diabetes communicate with each other and share information. This can be accomplished by giving patients information about the International Diabetic Athletes Association and, if available, local contacts that patients can talk to about shared experiences.

Diabetes and athletic performance is an area in need of further research. The studies done on carbohydrate loading and other strategies for optimizing athletic performance, carbohydrate/fluid replenishment during exercise, and nutritional strategies in the hours following training or competition have been primarily, if not exclusively, done in nondiabetic subjects. Data that have direct application to those with diabetes would be helpful in giving clearer direction to diabetic athletes. While most of the population will not choose to participate in competitive athletic events, it is very important that we encourage our patients to be more physically active. A better understanding of metabolic responses to and nutrition interventions for exercise in athletes with diabetes will provide important information with relevance to recreational and competitive athletes alike.

References

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Ann Albright, PhD, RD, is director of the California Diabetes Control Program at the University of California San Francisco/California Department of Health Services in Sacramento.

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