The Carbohydrate Debate: what is best for patients with diabetes?

The April 2003 Royal College of Physicians Nutrition Committee Report on Obesity prompted the headline media caption 'More than half of adults are too fat and getting fatter'. Over the last two decades obesity has increased threefold, with over 55% of the UK population now considered seriously overweight, resulting in many adverse health consequences including the dramatic rise in type 2 diabetes. The media obsession with body image and weight never ceases. Almost daily, new dietary strategies are declared, promising success and satisfaction. Such has been the remarkable popularity of Dr Robert Atkins' *Diet Revolution*, first published in 1972, promoting the simplistic concept that dietary carbohydrate of all kind was the main determinant of adverse glucose metabolism, inappropriate stimulation of insulin secretion and thereby undue weight gain.

Dr Atkins, who had advocated his diet from personal example, died on the 17 April 2003, at the age of 72 following an accidental head injury. His books sold many millions of copies, but how successful has his *Diet Revolution* proved? As with other popular diets, will the enthusiasm diminish now that the principal charismatic proponent has departed? With this debate we present two personal case histories – one from a person with type 2 and the other with type 1 diabetes – both of whom are convinced they have benefited from this type of diet. Details of significant improvement in measures of metabolic control and parallel reduction in prescribed medication are provided.

These individual accounts are submitted to encourage debate. Such radical dietary approaches will always be challenging, but should stimulate new ways of addressing this perennial dilemma. Putting these issues into pragmatic perspective, Jacqui Troughton provides an excellent analysis of current thinking on this subject and concludes with several sensible recommendations. Whatever one's viewpoint, new dietary approaches will always attract interest and controversy. Debate will continue. As with all its associated consequences, diabetes is a great magnifier of what happens in the normal population: unhealthy lifestyle and the consequences are greater; healthy lifestyle and better health outcomes result. Observations across a wide range of animals, including humans, that low calorie but nutritionally balanced diets have the potential to increase lifespan and prolong good health suggest that calorie restriction itself may be more important in delaying the ageing process, but we would probably need to reduce our calorie consumption by at least 30% to be effective. Eating is one of life's pleasures, but do we simply eat too much?

Professor Ken Shaw

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The low carbohydrate diet – personal experience in type 2 diabetes

Michael Arnold

Summary

Following the low-carbohydrate diet, defined by Drs Berstein, Eades and Atkins, I have lost 23% of my body weight and my blood sugar, total cholesterol and HbA_{1c} have all fallen. I have also been able to taper off my diabetes medication. This article summarises my experience with this dietary approach.

Introduction

During the past year, following a low carbohydrate diet, I have lost a total of 58lbs (26kg) (23% of my body weight); my blood sugar has dropped from 9.0mmol/L (morning spike) and 7.0mmol/L (evening) with medication to 7.0 and 5.2mmol/L respectively without medication. My total cholesterol has dropped from 7 to 4.4mmol/L and the HbA_{1C} from 7.5 to 5.1%.

Medication

When I started my diet, I was on the following medication for type 2 diabetes:

- Metformin – 850mg twice daily
- Gliclazide – 160mg twice daily
- Acarbose – 25mg three times daily.

I was able to taper these off and abandon all medication within two weeks of starting the diet.

The diet

I followed the low-carbohydrate diet defined by Drs Bernstein, Eades and Atkins. It is noteworthy that similar diets have been recommended since about 1864 (by William Banting) and subsequently by the Air Force diet, the Scarsdale diet and the Drinking Man's diet. All these were intended for weight loss and no diabetes improvement was mentioned. It was only Drs Bernstein and Eades (and, peripherally, Dr Atkins) who specifically recommended the diet for both type 1 and type 2 diabetes.

The basic diet consists of limiting intake of food and drink to protein and fat (preferably saturated), with a rigidly restricted intake of carbohydrate. In my case, I limited my total daily intake of carbohydrate to 12 grams, increasing it to 30–50 grams when my target weight and target blood sugar levels were achieved. The approximate percentages were: protein 65%, fat (mostly saturated) 33%, carbohydrate 2%.

This meant a total elimination of such standard foods as bread, pasta, rice, fruit and most vegetables, as well as all normal soft drinks. In spite of this, my vitamin and mineral intake has been adequate.

The diet requires very strong motivation and self-discipline. There is no hunger but long-established eating habits have to be changed. This is not really a diet (as normally understood), but a permanent change in lifestyle. The danger posed is that permission to eat large quantities of saturated fat (dairy products, fatty meats) – while actively avoiding all so-called low-fat products (which are higher in carbohydrate) – may be accepted while the subject continues with a normal carbohydrate intake; this is inadmissible and dangerous.

A food count book is essential to find out the carbohydrate content of food[3] – fibre content should be deducted from the carbohydrate count.

My own layman's view is that saturated fats only raise LDL-cholesterol if ingested with a normal intake of carbohydrate. Control one and the other decreases significantly.

This diet obviously wrenches the metabolic balance fairly radically. I have experienced no ill effects through this, though liver/kidney function (especially creatinine and urea) should be monitored due to the protein loading. Benign spin-offs have included a virtual elimination of peripheral neuropathy, arrested retinopathy and a feeling of general well-being.

Conclusion

The diet has worked very well for me and the effort has been worth it. Please note that all this applies to my experience only and must not be taken as a general recommendation. This is the function of specialists, not unqualified laymen.

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The low carbohydrate/low insulin regimen – personal experience in type 1 diabetes

Ron Raab

Summary

In this article, I describe my before and after experience in adopting a low carbohydrate/low insulin/moderate protein/appropriate fat approach to the management of my type 1 diabetes. The Diabetes Centre in New York specialises in this approach and this article is based on what I learnt there and have applied since June 1998. I outline the rationale for and advantages of this approach and the contradictions inherent in the high carbohydrate/high insulin approach. These are my personal views and do not represent the position of organisations with which I work.

Introduction

I was diagnosed with type 1 diabetes in 1957 at the age of six years, and started on one insulin injection daily increasing to two each day in 1959. In 1984 this increased to three injections daily and since 1994 to four each day.

I started self-blood glucose testing in 1980, and of course before that I was testing urine. I now test four times each day (using a plasma calibrated meter) and I also do moderate exercise two to three times per week.

I have had some background retinopathy and some neuropathy, including some delayed stomach emptying. This was worsening before I adopted this new regimen and was concerning me greatly. I tried my best to get really good blood glucose levels and applied the current Diabetes Association and professional medical, diabetes educators and dietitians high carbohydrate, low glycaemic advice. But I could not achieve continuously near normal glucose levels and was having more and more severe hypos as a result as well. The current advice did not work.

Low carbohydrate food plan

In 1998, through the many contacts I had made, I became aware of another approach – the low carbohydrate, low glycaemic index food plan together with much lower insulin doses and a choice of protein intake. I also visited a diabetes center in New York that specialises in this. Its Director Dr Richard Bernstein has had type 1 diabetes for over 50 years. He adopted this food plan many years ago after a lot of experimentation and reported that his diabetes control dramatically improved. I was also interested in this approach, as I had observed over many years that when my carbohydrate intake was lower, my blood sugar improved. This further encouraged me to try this very different food plan, while remaining sceptical and looking for results. I was intrigued by reports of normal HbA_{1c}s in Dr Bernstein's book[1] and internet site (http://www.diabetes-normalsugars.com), news reports and from personal accounts. The low carbohydrate diet was and continues to be discussed a lot in the USA and elsewhere and there is increasing discussion in diabetes journals and at conferences.

I experimented a lot and, since July 1998, have reduced my total daily carbohydrate intake from 200 grams then to 30–50 grams daily in 2000, all of a slowly absorbed type.

I do not regard this food plan as 'radical' or a 'fad', and should not be confused with more extreme food plans such as high protein or high saturated fat diets.

Results

My insulin dose has fallen by 55% to 16 units daily. My HbA_{1c} has fallen by 33% to 5.6% and continues to improve. There is much less variation in my daily blood glucose levels. Hypoglycemia is much less severe, and require only 3–5 grams of glucose tablets to ease the level back up. There are no more dramatic swings and 'time-out' is no longer needed for recovery, unlike with the high carbohydrate / high insulin regimen.

My weight has dropped from 84kg to 72kg with body mass index in the normal range; retinopathy has stabilised; blood pressure remains normal and lipids are in the normal / acceptable range and have remained so for most of the period of four years since I started this regimen, with the focus being on not over-consuming the 'wrong' type of fats. The weight loss was accompanied by some urine ketones but this has not been an issue since and is different to ketoacidosis due to lack of insulin, for example.

Importantly, my hunger has decreased (insulin is an appetite stimulant and this regimen has resulted in lower levels of insulin). I have more motivation, less frustration and my subjective quality of life and outlook have improved enormously. I also continue with regular mild exercise.

Rationale

Lowering daily carbohydrate intake makes sense on many levels. Why eat so much of a food type that is at the root of blood glucose instability and which requires more insulin in response, which in turn creates further problems. There is no evidence supporting high carbohydrate intake over lower intake in terms of blood glucose control, yet this is what is being generally advocated and promoted. Also kidney disease seems to occur subsequent to high blood glucose rather than higher protein intake, according to professionals such as Dr Bernstein and his expert colleagues. The general principles also apply to type 2 diabetes.

The greater the intake of carbohydrate, the greater the potential for unpredictability in the timing and size of the resultant increase in blood glucose. This is like adding more petrol to a fire that you cannot control! We also know that insulin absorption is variable, both between different injection sites and at different times. This variability also increases as the quantity of insulin injected increases. It therefore follows that a high carbohydrate and concomitant high insulin regimen must result in more erratic and unpredictable blood glucose profiles, compared to a low carbohydrate and appropriately matched low insulin regimen.

Surprisingly, this is implicit in the Medical Nutrition Therapy advice of the American Diabetes Association (ADA), the nutritional advice of Diabetes Australia and many other organisations. The ADA states that starchy (carbohydrate) foods will raise the blood glucose concentration and the increase will depend on the rate and completeness of digestion of the starch in a food, which is influenced by many factors. This clearly implies that the more starchy foods that are eaten at a meal, the greater the potential variability in blood glucose as a result. However, rather than logically recommending a lower carbohydrate intake, the advice is the opposite and recommends a high intake – up to 60% of calories from carbohydrate, which can mean up to 300 grams of carbohydrate per day in some individuals. Diabetes Australia provides similar recommendations.

Additionally, significant errors result from a 'high' carbohydrate meal. For example, a 20% variation (say 20 grams carbohydrate) in a meal is greater in absolute carbohdyrate than is recommended to treat a hypo. This does not occur in the case of a low carbohydrate meal because a 20% variation equals only a few grams of carbohydrate.

Delayed or variable stomach emptying (gastroparesis), which occurs as a result of impaired vagus nerve function (another form of diabetic nerve disease), further adds to variable and unpredictable blood glucose levels. The medical literature indicates that it occurs in 50% of patients with both type 1 and type 2 diabetes. This also contributes to greater blood glucose variability with higher carbohydrate intake. Large amounts of carbohydrate can remain in the stomach for variable periods of time, and then unpredictably, and possibly very suddenly, are 'processed' or 'emptied' resulting in a rapid increase in blood glucose. Gastroparesis can also increase the risk of hypos if a large amount of insulin is injected in response to a high carbohydrate meal and the carbohydrate remains in the stomach.

There is also continuing evidence of a relationship between 'high' insulin doses (which are implicit in the high carbohydrate regimen) and the development of vascular disease, including heart disease, independent of any other factor.

There is also increasing evidence of the damage that brief increases in blood sugar following meals can do in terms of the development of diabetes complications. Therefore, even if a patient's HbA_{1c} level is considered to be reasonably good, a high carbohydrate / high insulin regimen inevitably produces greater swings in blood sugar than a low carbohydrate / low insulin regimen, and further contributes to diabetes complications.

Meals

Just one example of a satisfying meal that contains 12 grams of carbohydrate and 120 grams of protein is:

- Soup made from stock
- Garden salad
- Medium-sized portion of steak, fish or vegetable protein
- Cooked vegetables (no potatoes or pasta)
- Coffee with a small amount of milk.

I have consulted with the chief of the Metabolic and Obesity Research Laboratory and Professor of Medicine and Biochemistry at Boston Medical Centre, USA. She saw no basis for concern with the

proportions and nature of the low carbohydrate, moderate protein, moderate fat regimen that underpins this approach. It is simple to design such a regimen to be nutritionally complete.

I have learned from such experts that protein and fat are essential nutrients, while carbohydrate is not. The body makes some carbohydrate from protein, particularly when carbohydrate from external food sources is low or non-existent. The body manufactures such carbohydrate slowly, making it a low-glycaemic index form of carbohydrate, matching the profile of regular insulin. About 10% of the 'real' or net protein of a food is converted in this way. There are no nutrients in high-carbohydrate foods that cannot be derived from other sources, for example vitamins and minerals that occur in fruit also occur in foods such as salads and vegetables. In any case, the regimen described in this article is a 'low carbohydrate', and not a 'no-carbohydrate', regimen.

Reactions

I have been invited to give my personal experience with this regimen at a number of professional health care meetings and diabetes associations in Australia, England and Japan. I made a presentation at the Australian Diabetes Society/Australian Diabetes Educators Association Annual Scientific Meeting in August 2000 at the symposium 'Carbohydrate – More or Less?'.

Following this presentation, my local physician, Dr Richard Arnott, made a number of comments to the participants, including that 'the improvement in Ron's HbA_{1c} has been dramatic… his previously severe hypoglycemia has abated… lipids remain in the acceptable range… there is a call for further studies... it is perhaps time to challenge the accepted dogmas…'

Professor Paul Moffitt, a diabetes specialist honoured for his contribution to diabetes care by the Australian government, wrote to me following my presentation that: 'I very definitely believe in a low carbohydrate diet and have done so for many years.'

A common response to this approach is that it is too extreme or difficult for the 'average' person to adopt. That is what I thought when I first came across it, yet having gone through the lifestyle change I am now marvellously happy with it and the results. Many may not want to reduce their total daily carbohydrate to 30 grams, which is the level needed to result in effectively normal blood sugars, but any significant move in this directon, say to 20 grams per meal (even if taking four meals daily) will result in major improvements if the insulin regimen is also tailored to it properly.

Conclusion

In this article I have tried to show the superiority of the low carbohydrate/low insulin regimen in terms of blood sugar control, as well as other benefits, compared with the high carbohydrate regimen.

In summary, less carbohydrate requires less insulin and this results in more predictability and less variation in blood glucose levels.

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Ron Raab, BEc, President, Insulin For Life Incorporated, Australia

Insulin For Life Incorporated (http://go.to/insulinforlife) was established in 1999, following my work at the International Diabetes Institute in Melbourne, Australia for 20 years.

Carbohydrate intake in diabetes: how much is optimal?

Jacqui Troughton

Summary

Nutritional advice that has little or no supporting evidence is still being given to people with diabetes. Advice pertaining to carbohydrate can be misleading. People with diabetes need evidence-based information about carbohydrates and to be given the knowledge and skills necessary to adjust their lifestyle, medication and/or insulin around the choices they wish to make.

Introduction

It is amazing how much controversy dietary advice for people with diabetes can evoke from health professionals and patients alike. No other nutrient causes such strong feeling as the role of carbohydrate. Perhaps concerns go back to the days before insulin was discovered when the only way for a person with type 1 diabetes to survive was completely to avoid carbohydrate, and dietary regimens were interesting to say the least.

The American Diabetes Association (ADA),[1] in its most recent position statement on nutrition principles, comment that 'in clinical practice, nutrition recommendations that have little or no supporting evidence have been and are still being given to persons with diabetes'.

There is still a belief by many that certain carbohydrate foods are bad because of their effect on blood sugars and the insulin response they elicit. Dietary advice regarding carbohydrates has been overly simplistic and non-evidence based, namely that good 'starchy' carbohydrate foods delay the release of glucose into the blood and bad 'sugary' carbohydrate foods swing blood sugars high.

Carbohydrate and glycaemic response

Research shows that many factors, rather than just whether a food is 'starchy' or 'sugary', influence the glycaemic responses to foods, e.g. the

amount of carbohydrate, type of sugar (glucose, fructose, sucrose, lactose), nature of starch (amylose, amylopectin, resistant starch), cooking and food processing, and food form as well as other food components.[2-5]

The terminology of carbohydrates can be confusing and whereas previously we have talked about simple sugars and complex carbohydrates, giving the illusion that chain length is the major effect on postprandial blood sugars, it is now preferable to talk about sugars, starches and fibre.

Different carbohydrates do elicit different insulin and glycaemic responses.[6] High postprandial plasma glucose excursions are assumed by some authors[7-9] to be independent predictors of risk for atherosclerotic diseases.

There are some that look at the DECODE study,[10] and suggest that as high postprandial blood sugars are associated with a higher cardiovascular risk, that foods that have a high glycaemic index (GI; carbohydrates that swing blood sugars high), should be avoided. It is questionable whether results from glucose tolerance tests can be translated to real food, which has a more variable effect.

In diabetic subjects, the chronic consumption of a low GI diet is generally found to improve plasma glucose and lipid profiles. In clinical practice, the chronic use of low GI foods is still questioned.[1,11]

Those who follow some media-published low GI diets can end up avoiding high GI foods that would be beneficial and replacing them with low GI, high fat foods that may have less health benefit. Care is needed to ensure that a low GI diet is a nutritionally balanced one and appropriate to the individual's needs.

In persons with type 1 and type 2 diabetes, there is no evidence from short-term studies that consumption of starches or sugars produces a different glycaemic response. It would appear that the total amount of carbohydrate in a meal or snack is more important than the source or type.

Studies in controlled settings and studies in free living subjects have shown both acutely and for up to six weeks, that subjects with type 1 or 2 diabetes ingesting a variety of starch or sugars produce no significant differences in glycaemic response, provided that the amount of carbohydrate was similar.[12,13]

Carbohydrate is the nutrient that most influences postprandial blood sugars, but does that mean that carbohydrate should be avoided? The DAFNE study[13] has caused much controversy in advocating that persons can eat as much or as little carbohydrate as wanted as long as it is covered by quick-acting insulin. There is no doubt from the quality of life scores that patients prefer to be less tied by carbohydrate at meal times and snacks, and it does not appear to have an adverse effect on HbA_{1c}. Longer term data will need to prove whether this advice has any detrimental effect on health. Initial data suggests there is no deterioration in cardiovascular risk. For individuals receiving fixed doses of insulin, day-to-day consistency of carbohydrate amount at meals and snacks becomes more important.

Can carbohydrate ever be too much of a good thing?

Studies suggest that diets where carbohydrate contributes to more than 60% of energy intake have detrimental metabolic effects.[14–17] These diets can increase serum triglyceride concentrations and insulin resistance, having the greatest adverse effect in insulin resistant states such as type 2 diabetes and pregnancy.

In those with type 2 diabetes on weight maintenance diets, replacing carbohydrate with monounsaturated fat reduces postprandial glycaemia and triglyceridaemia. The ADA advocate that if this is a preferred option for an individual with a healthy body weight, then carbohydrate and monounsaturated fat should provide 60–70% of energy intake.

Unfortunately, because of difficulties of weight management in people with type 2 diabetes, there has been caution in advising diets that are low in carbohydrate but high in monounsaturated fats because of the fact that fats of any nature contain double the calories of carbohydrate (1g fat provides 9kcals *vs* 1g carbohydrate 4kcals). It is advisable that advice in this area should be individualised based on nutritional assessment, metabolic profiles, treatment goals and patient choice.

What about high protein, low carbohydrate diets?

High protein, low carbohydrate diets have been fashionable on and off for years. Recently there has been a comprehensive review of these diets for weight loss by the American Heart Association.[18]

It must be remembered that with all weight loss programmes, weight loss cannot occur unless the person on the diet is in negative energy balance. When dietary carbohydrate is less than 50–100g (approximately 10–20% of total energy intake) per day, high levels of ketones are produced. These ketones induce metabolic ketosis and are initially attractive because they may induce quick weight loss. This weight loss however is attributable in part to the diuretic effect of a low carbohydrate intake and its effect on sodium and water loss, glycogen depletion and ketosis. As the diet is sustained, loss of appetite associated with ketosis helps with energy deficit. Short-term studies show that there is a more rapid and greater weight loss using high protein diets compared with higher carbohydrate diets.[19,20] Some studies show a beneficial effect on blood pressure, insulin and lipid levels, and glucose tolerance, but they do not directly compare them to hypocaloric diets of high carbohydrate, low fat diets.[21,22]

Efficacy and safety of high protein, low carbohydrate diets have not been demonstrated in long-term studies yet.

The amount of protein recommended in high protein diet regimens can vary (25–45% energy from protein), and exceed established requirements (15–20% energy from protein). This may impose significant health risks if consumed long term. In these diets, animal protein (rather than plant-based proteins that also contain carbohydrate) is normally advocated. A diet rich in animal protein, saturated fat and cholesterol raises low-density lipoprotein (LDL) cholesterol levels. This effect can be compounded

by the omission of carbohydrate and high-fibre plant foods from the diet that help lower cholesterol.

Food choices on a high protein diet may be severely limited if fruit, vegetables and cereals are restricted, which could lead to nutritional deficiencies in essential vitamins, minerals and fibre, if the diet was followed long term. This can, however, be a consequence of weight reduction programmes of any method.[23,24] Studies advocate the benefits of more fruit, vegetables and wholegrains.[25,26] A high protein diet may not reap these benefits.

A further concern of high protein, low carbohydrate diets would be that following exercise, glycogen levels should to be replenished by carbohydrate consumption. If this did not happen, fatigue would ensue. Some popular high protein/low carbohydrate diets limit carbohydrate to 10 to 20g per day, which is a fifth of the minimum 100g per day that is necessary to prevent loss of lean muscle tissue.

A common premise of high protein diets is that excess carbohydrate intake results in elevated insulin levels, which in turn promotes storage of body fat and has other metabolic consequences. However, protein intake also stimulates insulin secretion, although ingested protein does not directly increase plasma glucose concentrations. Insulin resistance or hyperinsulinaemia is complex, and regulated by many interrelating factors not just carbohydrate intake. It occurs as a result of obesity, or excess fat storage and lack of physical activity. It can be reduced by calorific restriction, via fat reduction and increased activity.

What about consuming 'average' protein portions?

The expert consensus from the American Diabetes Association[1] is that there is no evidence that the usual protein intake of the general population (15–20% of total energy) should be modified for people with diabetes if renal function is normal. Intakes of protein within the non-diabetic population range do not appear to be associated with the development of diabetic nephropathy. Following a low protein diet does not preserve renal function.[27]

The long-term effects of consuming a diet of greater than 20% of energy from protein on the development of nephropathy has not been determined and therefore it may be wise to avoid above average protein intakes.

Current recommendations

So, what about carbohydrate and protein recommendations for people with diabetes? The British Dietary Guidelines[28] have not been updated since the 1990s, but are currently being reviewed and are due for publication shortly.

Current recommendations from the ADA are that although diets high in protein may produce short-term weight loss and improved glycaemia, it has not been established that weight loss is maintained long-term. The long-term effects of such diets on plasma LDL-cholesterol are also a concern.

Foods containing carbohydrate from wholegrains, fruit and vegetables should be included in a healthy diet. With regards to the glycaemic effects of carbohydrates, the total amount of carbohydrate in meals or snacks is more important than the source or type. As sucrose does not increase glycaemia to a greater extent than isocaloric amounts of starch, it does not need to be restricted by people with diabetes. It can be substituted for other carbohydrate containing foods or, if added, covered with insulin or other glucose lowering medication.

Perhaps the most important thing to consider is that people with diabetes need evidence-based information about carbohydrates and knowledge and skills to adjust their medication/insulin around the choices they wish to make.

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Diet debate

Diet debate