Management of type 1 diabetes

Carbohydrate counting: An oversimplification

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Medicine, like life, is complicated. The art of clinical practice is to convert the often confusing and sometimes conflicting science into practical treatment and advice. Carbohydrate counting for individuals with T1D is one example where science has successfully translated into relatively straightforward clinical advice. Over the past 20 years, the work of the Düsseldorf group (Deutschen Diabetes-Zentrum) has been adapted using various teaching programmes to provide a straightforward approach to adjusting insulin doses meal-by-meal based on carbohydrate content (Mühlhauser et al, 1983). This approach does, however, assume that carbohydrate is the only macronutrient that influences blood glucose concentrations, and therefore insulin requirements. However, there is a wealth of evidence to argue that this is simply not the case, and the study by Wolpert and colleagues (summarised alongside) further adds to this in a simple practical demonstration.

A small group of people with T1D (*n*=7) volunteered for the crossover design study in which the authors compared the effect of a high-fat versus low-fat diet on insulin requirements and blood glucose control following a standardised meal with a fixed amount of carbohydrate. The high-fat meal resulted in a 42% increase in insulin dose requirement to maintain blood glucose concentrations. There were, however, marked individual differences; compared with the low-fat meal, one individual required more than twice as much insulin with the high-fat meal whilst another required slightly less insulin. It can be concluded that our current approach to carbohydrate counting has limitations, and we need to in some way incorporate variations in dietary fat into our teaching programmes.

The study by Wolpert et al is small but it builds on evidence that dietary fat is probably important in insulin adjustment. The study does, however, leave a number of questions unanswered, e.g. "Is this effect reproducible?" and "Is the effect large enough to significantly influence blood glucose control day-to-day when so many other factors are having an effect on glycaemia?" Perhaps, most importantly, we must consider that if the effect of dietary fat on insulin requirements is important, how do we build this in to training programmes that can be used by the majority of people with T1D, without producing something that is overly complex?

This study in itself will probably not change practice but it does remind us that our current carbohydrate counting programmes are a simplified version of reality, and that sometimes a more sophisticated approach will be needed.

Mühlhauser I, Jörgens V, Berger M et al (1983) Bicentric evaluation of a teaching and treatment programme for type 1 (insulin-dependent) diabetic patients: improvement of metabolic control and other measures of diabetes care for up to 22 months. *Diabetologia* **25**: 470–6

DIABETES CARE

Structured education in routine T1D care is effective

Readability	✓✓✓
Applicability to practice	✓✓
WOW! factor	✓

1 The authors investigated whether improvements in glycaemia and quality of life (QoL) reported in RCTs following self-management training are also found when the same training is delivered in routine UK healthcare.

2 A total of 262 people with T1D from 12 UK hospitals completed the Dose Adjustment for Normal Eating (DAFNE) educational programme. HbA_{1c} was measured 8 weeks before and 6 and 12 months after the programme. QoL was measured before DAFNE enrollment and 3, 6 and 12 months after completion.

3 QoL was significantly improved at 3 months, and this was maintained at 6 and 12 months. There was a clinically relevant improvement in HbA_{1c}; in a subgroup with suboptimal control (HbA_{1c} ≥58 mmol/mol [7.5%]), this remained significant at all three follow-up timepoints.

4 The longer-term improvements in glycaemia and QoL using DAFNE were also demonstrated in RCTs but with larger effect sizes. The authors stated that the results are encouraging given the rollout of DAFNE nationally and internationally.

Cooke D, Bond R, Lawton J et al (2012) Structured type 1 diabetes education delivered within routine care: Impact on glycemic control and diabetes-specific quality of life. *Diabetes Care* 8 Nov [Epub ahead of print]

DIABETES CARE

Dietary fat increases insulin requirements

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

1 The authors investigated whether seven people with T1D who had been receiving insulin pump therapy for >6 months would require more insulin coverage for higher-fat (HF) meals than for lower-fat (LF) meals.

2 In this crossover design study, two 18-hour periods of closed-loop insulin control over 2 days were compared following either an HF or an LF dinner.

3 Participants were given a bolus of insulin at lunchtime and encouraged to engage in mild-to-moderate physical activity in the afternoon whilst under open-loop insulin control.

4 In the evening, participants switched to closed-loop insulin control and were randomly assigned to either an HF or and LF meal (the carbohydrate and protein content of the meals was identical). Closed-loop control was continued until noon the following day.

5 On day 2, study methods were repeated – those who ate the HF meal on day one ate the LF meal, and vice versa. During the two periods of closed-loop control, venous glucose levels and plasma insulin levels were sampled.

6 The HF dinner required significantly more insulin than the LF dinner (12.6±1.9 units versus 9.0±1.3 units; P=0.01), increased the mean insulin requirement by 42% with marked individual differences, and caused significantly more hyperglycaemia, despite the additional insulin (P<0.0001).

7 The authors concluded that this evidence that dietary fat influences glycaemia highlights the limitations of the carbohydrate-based approach to bolus calculation currently used.

Wolpert HA, Atakov-Castillo A, Smith SA et al (2012) Dietary fat acutely increases glucose concentrations and insulin requirements in patients with type 1 diabetes. *Diabetes Care* 27 Nov [Epub ahead of print]

"Further research is needed into the extent to which addressing treatment non-compliance can improve life expectancy in people with T1D."

DIABETES CARE

Glycaemia after exercise

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓✓

1 The authors investigated the effect of resistance exercise on plasma glucose before, during and 24 hours after exercise in people with T1D versus aerobic exercise or no exercise.

2 Twelve physically active people with T1D and moderate-to-good glycaemic control completed three 45-minute test sessions (resistance exercise [three sets of eight repetitions with a maximum of seven exercises], aerobic exercise [treadmill exercise at 60% of VO_{2max}] and no exercise control [seated rest]), each separated by 5 days.

3 Participants reduced their insulin doses on exercise days. Interstitial glucose was measured 24 hours before and after, and during, exercise.

4 During resistance exercise, there was a gradual decline in plasma glucose (from 8.4±2.7 to 6.8±2.3 mmol/L; *P*=0.008). During aerobic exercise, there was a more dramatic decline in plasma glucose (from 9.2±3.4 to 5.8±2.0 mmol/L; *P*=0.001); significant changes from baseline were achieved within 10 minutes of activity.

5 Based on these and other findings, it was concluded that resistance exercise causes less initial blood glucose decline during activity, but more prolonged post-exercise reduction in glycaemia than aerobic exercise.

Yardley JE, Kenny GP, Perkins BA et al (2012) Resistance versus aerobic exercise. *Diabetes Care* 19 Nov [Epub ahead of print]

J DIABETES COMPLICATIONS

T1D: Compliance and all-cause mortality

Readability	✓✓✓
Applicability to practice	✓✓
WOW! factor	✓

1 In this observational cohort study, the authors investigated the relationship between poor treatment compliance (medication non-compliance and/or medical appointment non-attendance) and all-cause mortality in people with T1D.

2 Data on insulin-using people with T1D (*n*=2964) from more than 350 UK primary care practices were extracted from The Health Improvement Network (THIN) database

3 All people included in the analysis had data available for a 6-month "wash-in" period prior to T1D diagnosis and initiation of insulin therapy. A 30-day observation period followed during which time clinic attendance and medication adherence were assessed.

4 Mortality assessment began after the total 36 months of observation. All individuals were followed up until death, exit from the database (censorship), or the end of the study.

5 Following adjustment for confounding factors, treatment non-compliance was associated with increased all-cause mortality (hazard ratio, 1.642; 95% confidence interval, 1.055–2.554).

6 The authors concluded that further research is needed into the extent to which addressing treatment non-compliance can improve life expectancy in people with T1D.

Currie CJ, Peyrot M, Morgan CL et al (2012) The impact of treatment non-compliance on mortality in people with type 1 diabetes. *J Diabetes Complications* 13 Nov [Epub ahead of print].