

## Management of type 1 diabetes

### Frequency of self monitoring of blood glucose and HbA<sub>1c</sub>



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**A**t a recent diabetes clinic I met a woman with T1D who had been diagnosed in 1969. I found within her voluminous notes the first clinic entry the day she presented, which included the results of her urine

test:  
glucose +++++, ketones ++++. Later entries reported, "all urines blue", referring to a method for measuring glycosuria whereby blue indicates negative urinalysis. The patient recounted how she was introduced to capillary blood glucose monitoring over a decade later and the difference this had made to her life

(2 weeks in hospital for her second pregnancy compared to 12 weeks for her first).

Since then she had maintained an HbA<sub>1c</sub> between 50 and 60 mmol/mol (6.7% and 7.6%) with minimal

episodes of hypoglycaemia. She performed at least four blood tests a day – sometimes more – but latterly her GP practice had been limiting her to 50 strips per month. The study by Miller et al (summarised alongside) confirms previous data that in patients with T1D there is a direct correlation between frequency of self-monitoring of blood

***"The study by Miller et al confirms previous data that in patients with T1D there is a direct correlation between frequency of self-monitoring of blood glucose (SMBG) and lower HbA<sub>1c</sub>. SMBG alone, of course, is insufficient to help a person with diabetes achieve good control and structured education is essential."***

glucose (SMBG) and lower HbA<sub>1c</sub>. SMBG alone, of course, is insufficient to help a person with diabetes achieve good control and structured education is essential. Modern meters, which can be downloaded from, bolus advisers and carbohydrate counting all allow SMBG to be put to effective use. Commissioners of

health care need to read the study by Miller et al, as limiting prescriptions of blood glucose testing strips is short sighted, not evidence based, and a false economy.

### DIABETES CARE

### Frequent SMBG improves glycaemic control

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

**1** Previous evidence suggests that frequent self-monitoring of blood glucose (SMBG) is associated with improved glycaemic control. However, some insurers in the US limit the number of test strips available to people with T1D.

**2** The authors aimed to establish the relationship between SMBG measurements per day and HbA<sub>1c</sub> levels in a cohort of children and adults from the T1D Exchange Clinic Registry.

**3** A total of 20555 participants were included in the study, consisting of 11 641 individuals under the age of 18 and 8914 over 18 years of age. Linear regression models were applied to assess the relationship between SMBG measurements per day and HbA<sub>1c</sub> levels.

**4** Non-Hispanic white ethnicity, insurance coverage, high household income and insulin pump therapy were related to a higher number of SMBG measurements per day ( $P<0.001$ ).

**5** After statistical adjustment for these factors, an increased number of SMBG measurements per day was associated with lower HbA<sub>1c</sub> (adjusted  $P<0.001$ ). This association was present in insulin pump and injection users of all age groups.

**6** The authors concluded that there is a significant relationship between the number of SMBG measurements per day and HbA<sub>1c</sub> levels in people with T1D, suggesting that glycaemic control could be improved if a larger number of test strips were provided by insurers.

Miller KM, Beck RW, Bergenstal RM et al (2013) Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1C levels in T1D exchange clinic registry participants. *Diabetes Care* 1 Feb [Epub ahead of print]

### DIABETIC MEDICINE

### Hypoglycaemia-induced changes to brain morphology

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

**1** Insulin therapy resulting in severe hypoglycaemia (SH) can cause episodic memory impairments such as anterograde amnesia. There is little evidence investigating the long-term implications of SH on brain structure in people with T1D.

**2** The authors aimed to examine the long-term effects of SH on brain structure and the neurological correlates of memory performance in an individual with T1D.

**3** Total white matter lesion volume and regional grey and white matter volume were compared between a male with long-term anterograde amnesia resulting from hypoglycaemia and controls ( $n=20$ ).

**4** Reductions in grey matter volume in the hippocampus, thalamus and pallidum were observed in the individual with T1D. A significantly reduced white matter volume in the splenium, isthmus of the cingulate and cerebellum was also observed. The individual displayed an increased total white matter lesion volume compared to controls.

**5** The authors concluded that hypoglycaemia has the potential to induce permanent effects on brain structure and memory function.

Kirchoff BA, Lugar HM, Smith SE (2013) Hypoglycaemia-induced changes in regional brain volume and memory function. *Diabet Med* 30: e151–6

**“The authors concluded that the glycaemic load of large evening meals may alter absorption patterns, which could directly affect prandial insulin dosing in people with T1D.”**

## DIABETES

### Diurnal SI pattern is person-specific in T1D

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

**1** Recent evidence has revealed that individuals without diabetes exhibit a diurnal pattern of insulin action (SI), whereby SI decreases between breakfast and lunch. It is essential that physiological variations like these are accounted for in a closed-loop system, in order to achieve optimal glucose control and minimise the risk of hypoglycaemia.

**2** The authors sought to determine if a diurnal SI pattern is present in people with T1D. A total of 19 C-peptide negative individuals receiving insulin pump therapy were given identical meals for breakfast (B), lunch (L) or dinner (D) for 3 days. A triple tracer method was employed to measure glucose fluctuations.

**3** Postprandial glucose fluctuations were comparable after B, L and D. At B, insulin levels were greater ( $P < 0.01$ ) and endogenous glucose production was increased ( $P < 0.049$ ) compared to L.

**4** SI did not statistically differ between meals in participants with T1D ( $P = 0.34$ ), although the diurnal pattern of SI was different ( $P = 0.016$ ) compared to people without T1D. In contrast to people without T1D, people with T1D displayed an increasing SI from B to L.

**5** The authors concluded that diurnal SI is person-specific in individuals with T1D, and can not be generalised to the entire T1D population. This suggests that artificial pancreas algorithms should be personalised to account for this variability if optimal glucose control is to be achieved.

Hinshaw L, Man CD, Nandy DK et al (2013) Diurnal pattern of insulin action in type 1 diabetes: Implications for a closed loop system. *Diabetes* 27 Feb [Epub ahead of print]

## DIABETOLOGIA

### Absorption patterns, glycaemic load and insulin dosing

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

**1** An understanding of complex carbohydrate absorption is essential for successful postprandial glucose control.

**2** The authors undertook a prospective cohort study comparing the absorption patterns of a large low-glycaemic-load (LG) meal and a high-glycaemic-load (HG) meal matched for carbohydrates (121 g) in young individuals (16–24 years old,  $n = 16$ ) with T1D.

**3** Participants consumed the LG ( $n = 8$ ) or HG ( $n = 8$ ) evening meal on their first visit. A stable-label tracer dilution was performed to quantify glucose levels at the second visit. A variable-target glucose clamp test was also performed during visit 2 to replicate glucose and insulin levels from the first visit.

**4** Faster glucose appearance was observed after the HG meal with 25%, 50% and 75% cumulative glucose appearance at  $56 \pm 12$ ,  $100 \pm 25$  and  $153 \pm 39$  minutes ( $P < 0.001$  to 0.003) compared to  $88 \pm 21$ ,  $175 \pm 39$  and  $270 \pm 54$  minutes after the LG meal. Peak appearance of glucose was 50% higher after the HG meal ( $P < 0.001$ ).

**5** A 15% higher glucose bioavailability ( $P = 0.037$ ) was observed after the LG meal and a 20-minute deceleration of dietary mixed carbohydrates was observed when compared to dietary glucose in the HG meal.

**6** The authors concluded that the glycaemic load of large evening meals may alter absorption patterns, which could directly affect prandial insulin dosing in people with T1D.

Elleri D, Allen JM, Harris J et al (2013) Absorption patterns of meals containing complex carbohydrates in type 1 diabetes. *Diabetologia* 56: 1108–17

## DIABETES CARE

### Early-onset DSD: Aetiologically different to T1D?

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

**1** Children with Down Syndrome (DS) have an increased risk of childhood-onset diabetes. Research suggests that diabetes which occurs in children with DS before the age of 2 may aetiologically differ from T1D.

**2** The authors investigated whether early-onset diabetes in children with DS has an auto-immune basis or is aetiologically different to T1D.

**3** Blood samples from 136 children with DS and diabetes (DSD) were compared to 222 children with DS, 194 children with T1D and 671 controls.

**4** Early-onset diabetes occurred in more children with DS (22%) compared to T1D (4%;  $P < 0.0001$ ).

**5** The HLA genotype associated with the highest risk of T1D, DR3-DQ2/DR4-DQ8, had a reduced frequency in early and late-onset DSD compared to children with T1D ( $P < 0.0001$ ). The frequency of HLA DR3-DQ2 was increased ( $P = 0.004$ ) in this group.

**6** Persistent islet autoantibodies were observed in 72% of DSD children and antibodies to glutamic acid decarboxylase (GAD) were detected in all children ( $n = 5$ ) diagnosed with diabetes before or at the age of 2. Within the DSD cohort, 14% developed coeliac disease and 74% showed signs of thyroid disease.

**7** The authors concluded that early-onset diabetes in children with DS does not appear to be aetiologically different to T1D in older children, although a higher degree of autoimmunity is displayed in children with DSD.

Aitken RJ, Mehers KL, Williams AJ et al (2013) Early-onset, coexisting autoimmunity and decreased HLA-mediated susceptibility are the characteristics of diabetes in down syndrome. *Diabetes Care* 36: 1181–5