Technology

The role of CGM during pregnancy: Continual use may be required for optimal glycaemic control

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Murphy et al (2008) have previously shown that retrospective continuous glucose monitoring (CGM) used at 4–6 weekly intervals through pregnancy results in improved glycaemic control in the last few weeks of pregnancy and a reduction in macrosomia, with fewer large-for-gestational-age babies. Review of downloads from blinded sensors not only allows women to make adjustments to insulin therapy but also shows the impact of lifestyle change, particularly relating to diet. It would therefore be hoped that using real-time CGM, pregnant women with diabetes would be able to make more timely adjustments to their insulin regimen and diet, so that improved glycaemic control would be evident earlier in pregnancy, and in turn this would have a greater impact on the frequency of macrosomia.

Secher et al (summarised alongside) report a randomised trial of real-time CGM in pregnant women with diabetes. They recruited 123 women with T1D and 31 women with T2D and randomised them to real-time CGM for 6 days at 8, 12, 21, 27 and 33 weeks gestation or standard care. Only 64% of the women in the CGM arm used the technology per protocol. At 33 weeks there was no difference in $HbA_{1c,}$ self-monitored average blood glucose or frequency of severe hypoglycaemia; unsurprisingly there was no impact on frequency of large for gestational age infants or other perinatal outcomes.

Does this mean that real-time CGM does not have a role in pregnant women with diabetes? There are a number of explanations as to why the intervention failed to have an impact in this trial, which mean that the role and efficacy of real-time CGM in this setting remains uncertain.

The intervention was only offered as a single sensor at five discrete time points during the pregnancy. Other trials of real-time CGM in non-pregnant individuals have shown that frequency of sensor usage is critical to outcome, with usage in excess of 70% required to show benefit in most studies. In this trial the protocol dictated usage of 12.5% for the duration of the pregnancy; although women were encouraged to use real-time CGM continuously, especially if they suffered hypoglycaemia unawareness, and it was free of charge regardless of usage. Only five women (7%) chose to use it almost continuously (>60% of the time).

Glycaemic targets were the same for women in both arms of the study, and therapeutic adjustments were based on self-monitored blood glucose values, even when using real-time CGM. Given that one advantage of real-time CGM should be the ability to maintain tighter glycaemic targets whilst minimising the risk of hypoglycaemia by judicious use of the alarms, the potential of real-time CGM to have a significant impact on outcome appears to have been minimised by this strategy.

> *"Therefore, despite this negative study, real-time CGM may have a role for pregnant women who are prepared to use it most of the time to optimise intensive insulin regimens during pregnancy."*

In the cohort of women with T1D, 22% were using insulin pumps, the remainder relied on multiple daily injections (MDI). Only 39% of the women with T2D were on MDI, more of them (45%) being on insulin aspart mix. Indeed, one woman was not using insulin at all. Thus, those women using real-time CGM may not have been using the optimal regimen to maximise the benefit of CGM.

Therefore, despite this negative study, real-time CGM may have a role for pregnant women who are prepared to use it most of the time to optimise intensive insulin regimens during pregnancy. However it is worth noting the small number of women who chose to use it continuously in this study, even though offered free of charge, and this is consistent with our clinic observation of low uptake despite offering real-time CGM to all women with T1D on MDI or pumps during the latter half of pregnancy. This study fails to effectively address the potential of real-time CGM in influencing pregnancy outcome for women with diabetes, but it does point to some significant issues with the acceptability of the intervention.

Murphy HR, Rayman G, Lewis K et al (2008) Effectiveness of continuous glucose monitoring in pregnant women with diabetes: randomised clinical trial. *BMJ* **337**: a1680

DIABETES CARE

Intermittent GCM does not improve glycaemic control or pregnancy outcome

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

1 Maternal hyperglycaemia during pregnancy is associated with adverse perinatal outcomes such as preterm delivery and perinatal morbidity.

2 The authors of this study aimed to determine if glycaemic control and pregnancy outcome could be improved with intermittent real-time continuous glucose monitoring (CGM) in women pregestational diabetes.

3 Women with T1D (n=123) and T2D (n=33) were randomised to receive real-time CGM for 6 days at 8, 12, 21, 27 and 33 weeks of pregnancy in addition to routine care. Glycaemic control and perinatal outcomes were recorded and compared to women receiving routine care only.

4 Both HbA_{1c} (6.1 [range 5.1–7.8] versus 6.1% [range 4.8–8.2]; P=0.39) (43 [range 32–62] versus 43 mmol/mol [29–66]) and self-reported plasma glucose (6.2 [range 4.7–7.9] versus 6.2 mmol/L [range 4.9–7.9]; P=0.64) were comparable at 33 weeks between the two groups.

5 The incidence of large-for-gestational-age infants (45 versus 34%; P=0.19) and other perinatal outcomes did not significantly differ with CGM use compared to routine care.

6 The authors concluded that intermittent CGM combined with self-monitored plasma glucose did not improve glycaemic control or perinatal outcome in women with preexisting T1D or T2D.

Secher AL, Ringholm L, Andersen HU et al (2013) The effect of real-time continuous glucose monitoring in pregnant women with diabetes: a randomized controlled trial. *Diabetes Care* 24 Jan [Epub ahead of print]

NEW ENGLAND JOURNAL OF MEDICINE

Diabetes Camp: Artificial pancreas can reduce hypos

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

1 Artificial pancreas systems have been shown to reduce nocturnal hypoglycaemia in the hospital setting. Implementation of these systems outside the hospital, however, remains a challenge.

2 The authors aimed to determine the efficacy of an artificial pancreas system compared to a sensor-augmented pump (SAP) therapy for nocturnal glucose control in 56 patients aged 10 to 18 years with T1D.

3 Over two evenings, participants were randomly assigned to receive artificial pancreas therapy on the first night, followed by SAP therapy on the second night. This treatment order was reversed in the second group, so that all participants received both therapies in a randomised order.

4 Artificial pancreas therapy was correlated with significantly fewer episodes of nocturnal hypoglycaemia (seven versus 22; P=0.003) and reduced time during which glucose levels were below 60 mg/dL (3 mmol/L; P=0.02).

5 With the artificial pancreas, median overnight glucose levels were 126.4 mg/dL (interquartile range [IQR] 115.7–139.1 [7.0 mmol/L; IQR, 6.4–7.7]) and 140.4 mg/L (IQR, 105.7 to 167.4 [7.8 mmol/L; IQR, 5.9–9.3]) with the sensor-augmented pump.

6 The authors concluded that people treated with an artificial pancreas system experienced better glucose control and fewer episodes of nocturnal hypoglycaemia compared to SAP therapy

Phillip M, Battelino T, Atlas E et al (2013) N Nocturnal glucose control with an artificial pancreas at a diabetes camp. *N Engl J Med* **368**: 824–33

DIABETES TECHNOL THER

SAP therapy effective in lowering HbA_{1c}

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

1 The authors of the INTERPRET study aimed to prospectively establish the clinical value of sensor augmented pump (SAP) therapy in everyday life.

2 Participants (n=263) from 15 countries receiving CGM for T1D were followed for 12 months in this multicentric, observational study.

3 During the observation period, the average sensor use was 30% (range, 0–94%). Sensor use decreased from 37% in the first 3 months to 27% in the last 3 months of the study.

4 Frequent sensor use (P=0.047), high baseline HbA_{1c} (P<0.001) and older age group (P<0.001) were associated with improved HbA_{1c} after 12 months. Both the fear of hypoglycaemic episodes and the incidence of hospitalisation significantly decreased after 12 months of SAP.

5 The authors concluded that CGM is largely effective in pump users.

Nørgaard K, Scaramuzza A, Bratina N et al (2013) Routine sensor-augmented pump therapy in type 1 diabetes: The INTERPRET study. *Diabetes Technol Ther* 25 Feb [Epub ahead of print]

J DIABETES SCI TECHNOL

Surface coated OMIs lengthen SGMS life

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

1 The authors investigated the performance of an implantable subconjunctival glucose monitoring system (SGMS) in 47 people with diabetes. The feasibility of implantable ocular mini implants (OMI) with and without a biocompatible surface coating were tested over a period of 1 year.

2 Within the first 3 months, both types of OMI were well-tolerated and displayed mean absolute relative difference (MARD) values of 7–12%. After 3 months, performance was worse in uncoated OMIs (MARD 20%) compared to surface coated OMIs, which were preserved for 6 months (MARD 14%).

3 The authors concluded that biocompatable surface coating of OMIs is associated with an increased performance duration in SGMS devices.

Müller AJ, Knuth M, Nikolaus KS et al (2013) Blood glucose self-monitoring with a long-term subconjunctival glucose sensor. *J Diabetes Sci Technol* **1**: 24–34

EXP CLIN ENDOCRINOL DIABETES

Bolus calculators benefit glycaemic control

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

1 A meta-analysis was performed to compare insulin pump bolus calculators to standard insulin dosage calculations for glycaemic control.

2 Searches of MEDLINE, EMBASE and Cochrane Library identified six trials consisting of 354 participants with T1D for inclusion.

3 Fewer correction boluses (mean difference [MD] -2.31; 95% CI, -3.59 to -1.03; P=0.0004) and fewer hypoglycaemic episodes per week were observed in bolus calculator users (MD -0.47; 95% CI, -0.95 to 0.02; P=0.06).

4 The authors concluded that insulin pump bolus calculators are efficacious for insulin dose calculation.

Ramotowska A, Golicki D, Dzygało K et al (2013) The effect of using the insulin pump bolus calculator compared to standard insulin dosage calculations in patients with type 1 diabetes sellitus - Systematic review. *Exp Clin Endocrinol Diabetes* 17 Jan [Epub ahead of print]

> *"Artificial pancreas therapy was correlated with significantly fewer episodes of nocturnal hypoglycaemia (seven versus 22, P=0.003) and reduced time during which glucose levels were below 60 mg/dL (3 mmol/L; P=0.02)."*