Rapid Benefits of Structured Optimization and Sensor-Augmented Insulin Pump Therapy in Adults With Type 1 Diabetes

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We observed substantially improved glycemic control following addition of real-time continuous glucose monitoring (CGM) combined with structured education during run-in period in a study investigating prolonged use of day and night closed-loop.[1] This was an open-label, 3-center, multinational randomized 2-period crossover study comparing automated closed-loop glucose control with sensor-augmented insulin pump therapy (referred to as control period hereinafter) for 12 weeks. Participants were adults with type 1 diabetes treated with continuous subcutaneous insulin infusion (CSII) for at least 6 months with glycated hemoglobin (HbA1c) between 58 mmol/mol (7.5%) and 86 mmol/mol (10%). The detailed study protocol has been published.[2]

All participants underwent a 4 to 6 weeks optimization period prior to randomization. Weekly study visits conducted by professional pump educators followed an agreed written curriculum, and data from the study pump (Dana R Diabecare, Sooil, Seoul, South Korea) and CGM device (FreeStyle Navigator II, Abbott Diabetes Care, Alameda, CA, USA) were downloaded and analyzed. Formal testing was undertaken to assess the adequacy of basal insulin delivery and bolus calculator settings (insulin-to-carbohydrate ratio and sensitivity factor).

Thirty-three adults (15 females, age 40.0 ± 9.4 years, BMI 25.5 ± 4.4 kg/m^2, duration of diabetes 20.9 ± 9.3 years, and duration of pump therapy 7.8 ± 5.9 years) completed the optimization period. Baseline mean HbA1c at enrolment was 69 ± 7 mmol/mol ($8.5 \pm 0.7\%$). At the end of the 4 to 6 week optimization period mean HbA1c improved to 60 ± 9 mmol/mol ($7.6 \pm 0.8\%$) (see Figure 1) (paired difference, –9 mmol/mol [95% CI 6.8 to 11.2] or -0.8% [95% CI 0.6 to 1.0], $P < .001$). Mean sensor glucose (161 ± 27.6 mg/dl) and time below 50 mg/dl (0.4 [0.2 to 0.9]) during optimization were comparable to the control period. No severe hypoglycemia occurred during optimization. Total daily insulin dose was increased by a mean of 3 units (95% CI 0.3 to 5.8, $P = .029$). These improvements were maintained during the 3-month

control period (HbA1c at end of control period 59 ± 12 mmol/mol [$7.5 \pm 1.1\%$], paired difference before and after the control period, 0 mmol/mol [95% CI −2 to 2] or 0.0% [95% CI −0.2 to 0.2], $P = .79$). Both groups of participants, that is, those who did the control period first (n = 15) and second after the closed-loop period (n = 18), had significantly lower HbA1c at the end of control period compared to baseline ($P < .001$ and $P = .011$ respectively).

HbA1c improvements during optimization was negatively related to weight ($r = -0.35$, $P = .044$) and positively related to duration of pump therapy ($r = .5$, $P = .002$). However improvements were not related to baseline HbA1c ($P = .43$), age ($P = .48$), BMI ($P = .40$), duration of diabetes ($P = .50$), or total daily dose of insulin ($P = .95$).

Our result highlights the incremental value of real-time CGM combined with structured education in improving glycemic control in CSII patients with suboptimally controlled type 1 diabetes (HbA1c $\geq 7.5\%$). We observed impressive reductions of HbA1c levels, with very low time spent in biochemical hypoglycemia with no severe hypoglycemia in a relatively short period of time, not associated with baseline HbA1c levels. Experienced pump users benefitted the most.

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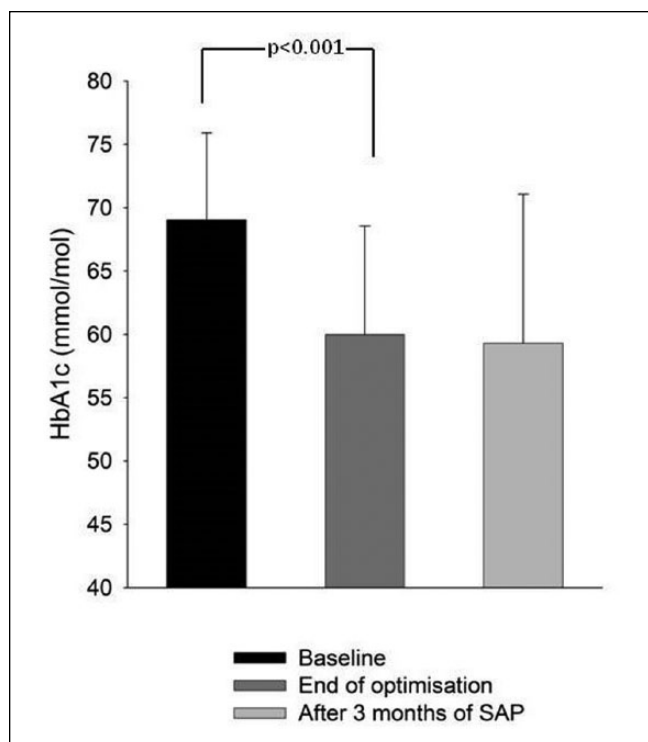
Figure 1. Mean HbA1c(SD) at baseline, after optimization and post 3 months of sensor augmented pump therapy.

Our data adds to existing evidence showing benefit of real-time CGM in improving glucose control in those already using CSII.[3,4] We acknowledge that attention bias related to study participation may have contributed to these improvements. Further investigations are warranted.

Abbreviations

CGM, continuous glucose monitoring; CI, confidence interval; CSII, continuous subcutaneous insulin infusion.

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Declaration of Conflicting Interests

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