Relationship between glucose variability and glycaemic control during sensor augmented pump therapy and closed-loop insulin delivery in adults with type 1 diabetes

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Introduction

Higher glycaemic variability is associated with severe hypoglycaemia[1] and may contribute to development of complications independent of HbA1c. Closed-loop glucose control and sensor augmented pump therapy has the potential to further improve glycaemic control whilst reducing the hypoglycaemia burden.

Objectives of the current study was to explore the relationship of glycaemic variability with glucose outcomes during sensor augmented pump therapy and closed-loop insulin delivery.

Methods

Post-hoc, exploratory analysis of published, day and night hybrid closed-loop study[2].

During an open-label, three-centre, multi-national randomised two-period crossover study, 33 adults with type 1 diabetes treated with continuous subcutaneous insulin infusion with HbA1c between 7.5% and 10% underwent automated closed-loop insulin delivery and sensor augmented pump therapy for 12 weeks.

Glycaemic variability was assessed using coefficient of variation of glucose over the entire three-month period.

Spearman rho was used for calculation of correlation coefficients between glucose outcomes and glycaemic variability.

Baseline characteristics

	N=33
Gender (F/M)	**15/18**
Age (years)	**40 ± 9**
Weight (kg)	**77.5 ± 15.0**
BMI (kg/m²)	**25.5 ± 4.4**
HbA1c (mmol/mol)	**69 ± 7**
Duration of diabetes (years)	**21 ± 9**
Duration on pump (years)	**8 ± 6**
Total daily insulin (U/kg/day)	**0.6 ± 0.1**

Table 1. Data are presented as mean ± SD, unless specified otherwise

References

1. Risk Factors Associated With Severe Hypoglycemia in Older Adults With Type 1 Diabetes. Weinstock RS et. al; Diabetes Care. 2016 Apr;39(4):603-10

2. Home Use of an Artificial Beta Cell in Type 1 Diabetes. Thabit H, Tauschmann M et. al. N Engl J Med. 2015 Nov 26;373(22):2129-40.

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Results

During sensor augmented pump therapy glycaemic variability was strongly associated with all levels of hypoglycaemia. In contrast, during closed loop treatment, there was no relationship with glycaemic variability with any level of hypoglycaemia. (Table and Figure)

Higher glycaemic variability during closed-loop was associated with higher mean glucose and higher HbA1c at the end of closed-loop treatment. There was no difference in glycaemic variability between sensor augmented pump therapy and closed-loop insulin delivery (39 ± 4% vs. 39 ± 4%, p=0.5).

	Sensor Augmented Pump (n=32)	Closed-loop (n=33)
Time spent at glucose level (%)		
<3.9mM	0.65 (<0.001)	0.14 (0.45)
<3.5mM	0.65 (<0.001)	0.15 (0.42)
<2.8 mM	0.72 (<0.001)	0.17 (0.36)
3.9 to 10 mM	0.19 (0.60)	- 0.70 (<0.001)
>10 mM	-0.21 (0.23)	0.63 (<0.001)
AUC< 3.5 mmol/l x min	0.72 (<0.001)	0.19 (0.29)
LBGI	0.62 (<0.001)	0.03 (0.86)
Mean glucose (mmol/l)	-0.17 (0.34)	0.60 (<0.001)
HbA1c Before	-0.05 (0.81)	0.29 (0.10)
HbA1c After	-0.21(0.25)	0.42 (0.01)

Table 2. Spearman Correlation Coefficients (P Values) between glucose outcomes and glucose variability (coefficient of variation) during closed-Loop and sensor augmented pump therapy (LBGI=Low Blood Glucose Index)

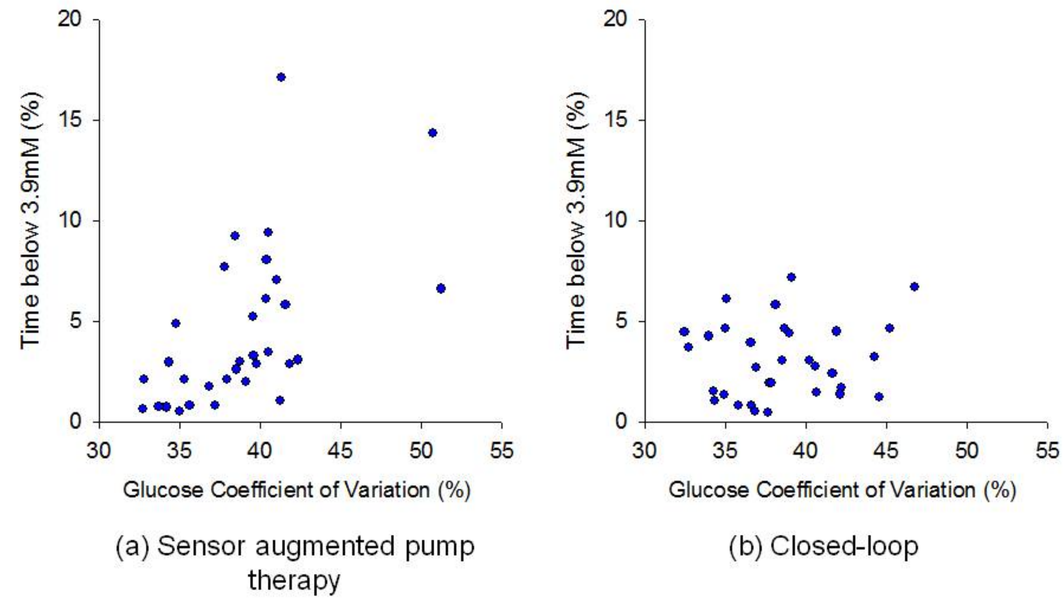

Figure 1. Relationship between time spent in hypoglycaemia and glucose variability

Conclusions

Higher glycaemic variability during sensor augmented pump therapy is strongly associated with higher time spent in hypoglycaemia.

Glycaemic variability was not related to time spent in hypoglycaemia during closed-loop but related to mean glucose, time spent in hyperglycaemia and HbA1c. Further work is required to understand the clinical relevance of these observations.